ID	Design Feature	Engineering Discipline	System/Topic	Hazard / Description
137	Hazardous Substances	Civil; Mechanical; Electrical; I&C	Contract Drawings	Hazardous and toxic substances existing on the project site can create safety and health hazards during construction.
138	Access Doors	Civil	Architectural	Access doors in floors and roofs present fall hazards when no guardrails are used around the doors when they are opened.
139	Doors	Civil	Architectural	Doors which open into passageways and work areas can strike other workers, and also limit the width of the passage or work area when open.
140	Doors	Civil	Architectural	Doors which open into passageways and work areas can strike other workers, and also limit the width of the passage or work area when open.
141	Doors	Civil	Architectural	Doors which open into passageways and work areas can strike other workers, and also limit the width of the passage or work area when open.
142	Doors	Civil	Architectural	Doors which open into passageways and work areas can strike other workers, and also limit the width of the passage or work area when open.
143	Doors	Civil	Architectural	Doors which open into passageways and work areas can strike other workers, and also limit the width of the passage or work area when open.
144	Doors	Civil	Architectural	Doors which open into passageways and work areas can strike other workers, and also limit the width of the passage or work area when open.
145	Doors	Civil	Architectural	Doors which open into passageways and work areas can strike other workers, and also limit the width of the passage or work area when open.
146	Windows	Civil	Architectural	Prior to installation of upper story windows, low sill heights add to the chance of falling through the window openings.
147	Windows	Civil	Architectural	Prior to installation of upper story windows, low sill heights add to the chance of falling through the window openings.
148	Siding	Civil	Architectural	Try to engineer, procure and install without any scope changes.
149	Siding	Civil	Architectural	Try to engineer, procure and install without any scope changes.
150	Siding	Civil	Architectural	Try to engineer, procure and install without any scope changes.
151	Siding	Civil	Architectural	Try to engineer, procure and install without any scope changes.
152	Siding	Civil	Architectural	Try to engineer, procure and install without any scope changes.
153	Siding	Civil	Architectural	Try to engineer, procure and install without any scope changes.

154	Siding	Civil	Architectural	Try to engineer, procure and install without any scope changes.
155	Siding	Civil	Architectural	Try to engineer, procure and install without any scope changes.
156	Siding	Civil	Architectural	Try to engineer, procure and install without any scope changes.
157	Siding	Civil	Architectural	Try to engineer, procure and install without any scope changes.
158	Siding	Civil	Architectural	Try to engineer, procure and install without any scope changes.
159	Siding	Civil	Architectural	Try to engineer, procure and install without any scope changes.
160	Siding	Civil	Architectural	Try to engineer, procure and install without any scope changes.
161	Siding	Civil	Architectural	Try to engineer, procure and install without any scope changes.
162	Siding	Civil	Architectural	Try to engineer, procure and install without any scope changes.
163	Code	Civil	Architectural	Determine code requirements during the scoping and conceptual phase of the project.
164	Code	Civil	Architectural	Determine code requirements during the scoping and conceptual phase of the project.
165	Code	Civil	Architectural	Determine code requirements during the scoping and conceptual phase of the project.
166	Code	Civil	Architectural	Determine code requirements during the scoping and conceptual phase of the project.
167	Excavations	Civil	Sitework	Excavations can present cave-in hazards for construction workers.
168	Excavations	Civil	Sitework	Excavations can present cave-in hazards for construction workers.
169	Excavations	Civil	Sitework	Excavations can present cave-in hazards for construction workers.
170	Excavations	Civil	Sitework	Excavations can present cave-in hazards for construction workers.
171	Excavations	Civil	Sitework	Excavations can present cave-in hazards for construction workers.
172	Excavations	Civil	Sitework	Excavations can present cave-in hazards for construction workers.
173	Excavations	Civil	Sitework	Excavations can present cave-in hazards for construction workers.
174	Excavations	Civil	Sitework	Excavations can present cave-in hazards for construction workers.
175	Excavations	Civil	Sitework	Excavations can present cave-in hazards for construction workers.

176	Excavations	Civil	Sitework	Excavations can present cave-in hazards for construction workers.
177	Excavations	Civil	Sitework	Excavations can present cave-in hazards for construction workers.
178	Excavations	Civil	Sitework	Excavations can present cave-in hazards for construction workers.
179	Trenches	Civil	Sitework	Trench excavation for underground utilities can lead to cave-in hazards for construction workers.
180	Trenches	Civil	Sitework	Trench excavation for underground utilities can lead to cave-in hazards for construction workers.
181	Trenches	Civil	Sitework	Trench excavation for underground utilities can lead to cave-in hazards for construction workers.
182	Storm Sewers	Civil	Sitework	Inadequate sewer coverings and bypasses can create safety hazards for construction workers.
183	Storm Sewers	Civil	Sitework	Inadequate sewer coverings and bypasses can create safety hazards for construction workers.
184	Storm Sewers	Civil	Sitework	Inadequate sewer coverings and bypasses can create safety hazards for construction workers.
185	Storm Sewers	Civil	Sitework	Inadequate sewer coverings and bypasses can create safety hazards for construction workers.
186	Storm Sewers	Civil	Sitework	Inadequate sewer coverings and bypasses can create safety hazards for construction workers.
187	Storm Sewers	Civil	Sitework	Inadequate sewer coverings and bypasses can create safety hazards for construction workers.
188	Process Sewers	Civil	Sitework	Sewer systems which are not designed for the surrounding conditions and the liquids they will carry can be safety hazards for construction workers.
189	Process Sewers	Civil	Sitework	Sewer systems which are not designed for the surrounding conditions and the liquids they will carry can be safety hazards for construction workers.
190	Process Sewers	Civil	Sitework	Sewer systems which are not designed for the surrounding conditions and the liquids they will carry can be safety hazards for construction workers.
191	Process Sewers	Civil	Sitework	Sewer systems which are not designed for the surrounding conditions and the liquids they will carry can be safety hazards for construction workers.
192	Process Sewers	Civil	Sitework	Sewer systems which are not designed for the surrounding conditions and the liquids they will carry can be safety hazards for construction workers.
193	Underground Utilities	Civil	Sitework	Existing underground utilities create safety hazards for construction workers during excavation and installation of piles or caissons.
194	Underground Utilities	Civil	Sitework	Existing underground utilities create safety hazards for construction workers during excavation and installation of piles or caissons.

195	Underground Utilities	Civil	Sitework	Existing underground utilities create safety hazards for construction workers during excavation and installation of piles or caissons.
196	Underground Utilities	Civil	Sitework	Existing underground utilities create safety hazards for construction workers during excavation and installation of piles or caissons.
197	Underground Utilities	Civil	Sitework	Existing underground utilities create safety hazards for construction workers during excavation and installation of piles or caissons.
198	Slopes	Civil	Sitework	Project sites which contain steep slopes and limited sight distances can lead to safety hazards for construction workers.
199	Slopes	Civil	Sitework	Project sites which contain steep slopes and limited sight distances can lead to safety hazards for construction workers.
200	Slopes	Civil	Sitework	Project sites which contain steep slopes and limited sight distances can lead to safety hazards for construction workers.
201	Slopes	Civil	Sitework	Project sites which contain steep slopes and limited sight distances can lead to safety hazards for construction workers.
202	Sidewalk	Civil	Sitework	Exterior walkways and other flatwork can lead to tripping and slipping hazards for construction workers.
203	Sidewalk	Civil	Sitework	Exterior walkways and other flatwork can lead to tripping and slipping hazards for construction workers.
204	General	Electrical	Electrical	Electrical: General
205	General	Electrical	Electrical	Electrical: General
206	General	Electrical	Electrical	Electrical: General
207	General	Electrical	Electrical	Electrical: General
208	General	Electrical	Electrical	Electrical: General
209	General	Electrical	Electrical	Electrical: General
210	Equipment	Electrical	Electrical	Electrical: Equipment
211	Equipment	Electrical	Electrical	Electrical: Equipment
212	Equipment	Electrical	Electrical	Electrical: Equipment
213	Equipment	Electrical	Electrical	Electrical: Equipment
214	Equipment	Electrical	Electrical	Electrical: Equipment
215	Equipment	Electrical	Electrical	Electrical: Equipment
216	Equipment	Electrical	Electrical	Electrical: Equipment

217	Equipment	Electrical	Electrical	Electrical: Equipment
218	Equipment	Electrical	Electrical	Electrical: Equipment
219	Equipment	Electrical	Electrical	Electrical: Equipment
220	Grounding and Lightning Protection	Electrical	Electrical	Electrical: Grounding and Lightning Protection
221	Grounding and Lightning Protection	Electrical	Electrical	Electrical: Grounding and Lightning Protection
222	Grounding and Lightning Protection	Electrical	Electrical	Electrical: Grounding and Lightning Protection
223	Grounding and Lightning Protection	Electrical	Electrical	Electrical: Grounding and Lightning Protection
224	Grounding and Lightning Protection	Electrical	Electrical	Electrical: Grounding and Lightning Protection
225	Grounding and Lightning Protection	Electrical	Electrical	Electrical: Grounding and Lightning Protection
226	Raceways	Electrical	Electrical	Electrical: Raceways
227	Raceways	Electrical	Electrical	Electrical: Raceways
228	Raceways	Electrical	Electrical	Electrical: Raceways
229	Raceways	Electrical	Electrical	Electrical: Raceways
230	Raceways	Electrical	Electrical	Electrical: Raceways
231	Raceways	Electrical	Electrical	Electrical: Raceways
232	Raceways	Electrical	Electrical	Electrical: Raceways
233	Cables	Electrical	Electrical	Electrical: Cables
234	Cables	Electrical	Electrical	Electrical: Cables
235	Cables	Electrical	Electrical	Electrical: Cables
236	Cables	Electrical	Electrical	Electrical: Cables
237	Lighting	Civil	Electrical	The design and erection sequence of lighting systems can affect the safety of construction workers.
238	Lighting	Electrical	Electrical	The design and erection sequence of lighting systems can affect the safety of construction workers.

239	Lighting	Electrical	Electrical	The design and erection sequence of lighting systems can affect the safety of construction workers.
240	Lighting	Electrical	Electrical	The design and erection sequence of lighting systems can affect the safety of construction workers.
241	Lighting	Electrical	Electrical	The design and erection sequence of lighting systems can affect the safety of construction workers.
242	Lighting	Electrical	Electrical	The design and erection sequence of lighting systems can affect the safety of construction workers.
243	Lighting	Electrical	Electrical	The design and erection sequence of lighting systems can affect the safety of construction workers.
244	Lighting	Electrical	Electrical	The design and erection sequence of lighting systems can affect the safety of construction workers.
245	Communication System	Electrical	Electrical	Electrical: Communication System
246	Communication System	Electrical	Electrical	Electrical: Communication System
247	Tagging and Signage	Electrical	Electrical	Electrical: Tagging and Signage
248	Tagging and Signage	Electrical	Electrical	Electrical: Tagging and Signage
249	Tagging and Signage	Electrical	Electrical	Electrical: Tagging and Signage
250	Tagging and Signage	Electrical	Electrical	Electrical: Tagging and Signage
251	Tagging and Signage	Electrical	Electrical	Electrical: Tagging and Signage
252	Technical Services	Electrical	Electrical	Electrical: Technical Services
253	Technical Services	Electrical	Electrical	Electrical: Technical Services
254	Technical Services	Electrical	Electrical	Electrical: Technical Services
255	Technical Services	Electrical	Electrical	Electrical: Technical Services
256	Technical Services	Electrical	Electrical	Electrical: Technical Services
257	Coatings	Civil	Corosion Protection And Insulation	The selection of coating materials can affect the safety and health of construction workers.
258	Erection	Civil	Corosion Protection And Insulation	The erection sequence or placement procedures for furnishings and finishes can affect the safety of construction workers.
259	Design	Civil	Handrail, Guardrail	Inadequately designed handrails, guardrails, and stairrails can lead to obstruction and fall hazards for construction & operations workers.
260	Design	Civil	Handrail, Guardrail	Inadequately designed handrails, guardrails, and stairrails can lead to obstruction and fall hazards for construction & operations workers.
261	Design	Civil	Handrail, Guardrail	Inadequately designed handrails, guardrails, and stairrails can lead to obstruction and fall hazards for construction & operations workers.

262	Design	Civil	Handrail, Guardrail	Inadequately designed handrails, guardrails, and stairrails can lead to obstruction and fall hazards for construction & operations workers.
263	Design	Civil	Handrail, Guardrail	Inadequately designed handrails, guardrails, and stairrails can lead to obstruction and fall hazards for construction & operations workers.
264	Design	Civil	Handrail, Guardrail	Inadequately designed handrails, guardrails, and stairrails can lead to obstruction and fall hazards for construction & operations workers.
265	Design	Civil	Handrail, Guardrail	Inadequately designed handrails, guardrails, and stairrails can lead to obstruction and fall hazards for construction & operations workers.
266	Design	Civil	Handrail, Guardrail	Inadequately designed handrails, guardrails, and stairrails can lead to obstruction and fall hazards for construction & operations workers.
267	Railing Dimensions	Civil	Handrail, Guardrail	Handrail and railing dimensions can affect the safety of construction workers.
268	Railing Dimensions	Civil	Handrail, Guardrail	Handrail and railing dimensions can affect the safety of construction workers.
269	Railing Dimensions	Civil	Handrail, Guardrail	Handrail and railing dimensions can affect the safety of construction workers.
270	Openings	Civil	Handrail, Guardrail	Roof openings can create fall hazards for construction workers if they are numerous or not adequately guarded. Stairs and elevated walkways and platforms can lead to falls during construction before handrails, guardrails, and stairrails are erected.
271	Openings	Civil	Handrail, Guardrail	Roof openings can create fall hazards for construction workers if they are numerous or not adequately guarded. Stairs and elevated walkways and platforms can lead to falls during construction before handrails, guardrails, and stairrails are erected.
272	Openings	Civil	Handrail, Guardrail	Roof openings can create fall hazards for construction workers if they are numerous or not adequately guarded. Stairs and elevated walkways and platforms can lead to falls during construction before handrails, guardrails, and stairrails are erected.
273	Stairs	Civil	Handrail, Guardrail	
274	Controls	Mechanical	Mechanical/Hvac	Mechanical/HVAC controls can create safety hazards for construction workers if they protrude into passageways, or are hard to operate, hidden, or inaccessible.
275	Controls	Mechanical	Mechanical/Hvac	Mechanical/HVAC controls can create safety hazards for construction workers if they protrude into passageways, or are hard to operate, hidden, or inaccessible.

276	Controls	Mechanical	Mechanical/Hvac	Mechanical/HVAC controls can create safety hazards for construction workers if they protrude into passageways, or are hard to operate, hidden, or inaccessible.
277	Controls	Mechanical	Mechanical/Hvac	Mechanical/HVAC controls can create safety hazards for construction workers if they protrude into passageways, or are hard to operate, hidden, or inaccessible.
278	Controls	Mechanical	Mechanical/Hvac	Mechanical/HVAC controls can create safety hazards for construction workers if they protrude into passageways, or are hard to operate, hidden, or inaccessible.
279	Electrical/Grounding	Electrical	Mechanical/Hvac	Adequate electrical protection and grounding of equipment is essential to prevent electrical shock hazards.
280	Electrical/Grounding	Electrical	Mechanical/Hvac	Adequate electrical protection and grounding of equipment is essential to prevent electrical shock hazards.
281	Electrical/Grounding	Electrical	Mechanical/Hvac	Adequate electrical protection and grounding of equipment is essential to prevent electrical shock hazards.
282	Equipment Cooling	Electrical; Mechanical	Mechanical/Hvac	Inadequate cooling and ventilation of electrical equipment can lead to fire hazards during the construction phase.
283	Equipment Location	Mechanical	Mechanical/Hvac	The location of mechanical and HVAC systems within a project can lead to fall, ergonomic, and other safety hazards for construction workers.
284	Equipment Location	Mechanical	Mechanical/Hvac	The location of mechanical and HVAC systems within a project can lead to fall, ergonomic, and other safety hazards for construction workers.
285	Equipment Location	Mechanical	Mechanical/Hvac	The location of mechanical and HVAC systems within a project can lead to fall, ergonomic, and other safety hazards for construction workers.
286	Equipment Location	Mechanical	Mechanical/Hvac	The location of mechanical and HVAC systems within a project can lead to fall, ergonomic, and other safety hazards for construction workers.
287	Equipment Materials	Mechanical	Mechanical/Hvac	Mechanical and HVAC systems which are not constructed of materials adequate for the expected construction environment and loading create safety hazards for construction workers.
288	Equipment Supports	Mechanical	Mechanical/Hvac	Mechanical and HVAC systems and their supports which are not designed to withstand all anticipated construction loading present collapse and fall hazards to construction workers.
289	Equipment Supports	Mechanical	Mechanical/Hvac	Mechanical and HVAC systems and their supports which are not designed to withstand all anticipated construction loading present collapse and fall hazards to construction workers.
290	Piping	Mechanical	Mechanical/Hvac	Piping elements which are not designed with consideration of the connecting mechanical and HVAC units can lead to safety hazards during construction and initial startup phases.
291	Piping	Mechanical	Mechanical/Hvac	Piping elements which are not designed with consideration of the connecting mechanical and HVAC units can lead to safety hazards during construction and initial startup phases.

292	Piping	Mechanical	Mechanical/Hvac	Piping elements which are not designed with consideration of the connecting mechanical and HVAC units can lead to safety hazards during construction and initial startup phases.
293	Piping	Mechanical	Mechanical/Hvac	Piping elements which are not designed with consideration of the connecting mechanical and HVAC units can lead to safety hazards during construction and initial startup phases.
294	Valves	Mechanical	Mechanical/Hvac	Valve location and operation can lead to safety hazards for construction workers during the construction and initial startup phases.
295	Valves	Mechanical	Mechanical/Hvac	Valve location and operation can lead to safety hazards for construction workers during the construction and initial startup phases.
296	Valves	Mechanical	Mechanical/Hvac	Valve location and operation can lead to safety hazards for construction workers during the construction and initial startup phases.
297	Valves	Mechanical	Mechanical/Hvac	Valve location and operation can lead to safety hazards for construction workers during the construction and initial startup phases.
298	Ventilating Equipment	Mechanical	Mechanical/Hvac	Adequate ventilation for construction workers during the construction phase is essential for a safe work environment.
299	Ventilating Equipment	Mechanical	Mechanical/Hvac	Adequate ventilation for construction workers during the construction phase is essential for a safe work environment.
300	Ventilating Equipment	Mechanical	Mechanical/Hvac	Adequate ventilation for construction workers during the construction phase is essential for a safe work environment.
301	Ventilating Equipment	Mechanical	Mechanical/Hvac	Adequate ventilation for construction workers during the construction phase is essential for a safe work environment.
302	Work Area A	Mechanical	Mechanical/Hvac	An enclosed or congested work area surrounding mechanical and HVAC equipment can affect the safety of workers during installation and maintenance of the equipment.
303	Work Area A	Mechanical	Mechanical/Hvac	An enclosed or congested work area surrounding mechanical and HVAC equipment can affect the safety of workers during installation and maintenance of the equipment.
304	Work Area A	Mechanical	Mechanical/Hvac	An enclosed or congested work area surrounding mechanical and HVAC equipment can affect the safety of workers during installation and maintenance of the equipment.
305	Work Area A	Mechanical	Mechanical/Hvac	An enclosed or congested work area surrounding mechanical and HVAC equipment can affect the safety of workers during installation and maintenance of the equipment.
306	Work Area B	Mechanical	Mechanical/Hvac	The floor area and support structure surrounding mechanical and HVAC systems can create safety hazards during placement of the equipment and work around the equipment.
307	Work Area B	Mechanical	Mechanical/Hvac	The floor area and support structure surrounding mechanical and HVAC systems can create safety hazards during placement of the equipment and work around the equipment.

308	Work Area B	Mechanical	Mechanical/Hvac	The floor area and support structure surrounding mechanical and HVAC systems can create safety hazards during placement of the equipment and work around the equipment.
309	Work Area B	Mechanical	Mechanical/Hvac	The floor area and support structure surrounding mechanical and HVAC systems can create safety hazards during placement of the equipment and work around the equipment.
310	Work Area C	Mechanical	Mechanical/Hvac	Work areas without adequate protection from equipment noise, electrical shock, or moving parts are hazardous for construction workers.
311	Work Area C	Mechanical	Mechanical/Hvac	Work areas without adequate protection from equipment noise, electrical shock, or moving parts are hazardous for construction workers.
312	Work Area C	Mechanical	Mechanical/Hvac	Work areas without adequate protection from equipment noise, electrical shock, or moving parts are hazardous for construction workers.
313	Work Area C	Mechanical	Mechanical/Hvac	Work areas without adequate protection from equipment noise, electrical shock, or moving parts are hazardous for construction workers.
314	Work Area C	Mechanical	Mechanical/Hvac	Work areas without adequate protection from equipment noise, electrical shock, or moving parts are hazardous for construction workers.
315	Erection	Mechanical	Mechanical/Hvac	The erection or placement operations required for mechanical and HVAC systems can create safety hazards for construction workers.
316	Erection	Mechanical	Mechanical/Hvac	The erection or placement operations required for mechanical and HVAC systems can create safety hazards for construction workers.
317	Erection	Mechanical	Mechanical/Hvac	The erection or placement operations required for mechanical and HVAC systems can create safety hazards for construction workers.
318	Erection	Mechanical	Mechanical/Hvac	The erection or placement operations required for mechanical and HVAC systems can create safety hazards for construction workers.
319	Existing Structure	Mechanical	Mechanical/Hvac	Working with and connecting to existing mechanical and HVAC systems presents safety hazards for construction workers.
320	Testing	Mechanical	Mechanical/Hvac	Sufficient testing of mechanical and HVAC systems is essential to eliminate safety hazards due to failure of the systems.
321	Testing	Mechanical	Mechanical/Hvac	Sufficient testing of mechanical and HVAC systems is essential to eliminate safety hazards due to failure of the systems.

322	Controls/Valves A	Mechanical; I&C	Piping	The design of piping controls and valves can lead to safety hazards for construction workers.
323	Controls/Valves A	Mechanical; I&C	Piping	The design of piping controls and valves can lead to safety hazards for construction workers.
324	Controls/Valves A	Mechanical; I&C	Piping	The design of piping controls and valves can lead to safety hazards for construction workers.
325	Controls/Valves A	Mechanical; I&C	Piping	The design of piping controls and valves can lead to safety hazards for construction workers.
326	Controls/Valves B	Mechanical; I&C	Piping	The design of piping controls and valves can lead to safety hazards for construction workers.
327	Controls/Valves B	Mechanical; I&C	Piping	The design of piping controls and valves can lead to safety hazards for construction workers.
328	Controls/Valves B	Mechanical; I&C	Piping	The design of piping controls and valves can lead to safety hazards for construction workers.
329	Controls/Valves B	Mechanical; I&C	Piping	The design of piping controls and valves can lead to safety hazards for construction workers.
330	Controls/Valves B	Mechanical; I&C	Piping	The design of piping controls and valves can lead to safety hazards for construction workers.
331	Controls/Valves C	Mechanical	Piping	The design of piping controls and valves can lead to safety hazards for construction workers.
332	Controls/Valves C	Mechanical	Piping	The design of piping controls and valves can lead to safety hazards for construction workers.
333	Controls/Valves C	Mechanical	Piping	The design of piping controls and valves can lead to safety hazards for construction workers.
334	Controls/Valves C	Mechanical	Piping	The design of piping controls and valves can lead to safety hazards for construction workers.
335	Controls/Valves C	Mechanical	Piping	The design of piping controls and valves can lead to safety hazards for construction workers.
336	Drains	Mechanical	Piping	Drains can create tripping and slipping hazards for construction workers.
337	Drains	Mechanical	Piping	Drains can create tripping and slipping hazards for construction workers.
338	Drains	Mechanical	Piping	Drains can create tripping and slipping hazards for construction workers.
339	Drains	Mechanical	Piping	Drains can create tripping and slipping hazards for construction workers.
340	Hazardous Fluids	Mechanical	Piping	Piping systems which contain hazardous fluids can present safety hazards for construction workers.
341	Hazardous Fluids	Mechanical	Piping	Piping systems which contain hazardous fluids can present safety hazards for construction workers.

342	Hazardous Fluids	Mechanical	Piping	Piping systems which contain hazardous fluids can present safety hazards for construction workers.
343	Pipes A	Mechanical	Piping	The design of piping materials and welds, and the identification of piping contents, can affect the safety of construction workers.
344	Pipes A	Mechanical	Piping	The design of piping materials and welds, and the identification of piping contents, can affect the safety of construction workers.
345	Pipes A	Mechanical	Piping	The design of piping materials and welds, and the identification of piping contents, can affect the safety of construction workers.
346	Pipes A	Mechanical	Piping	The design of piping materials and welds, and the identification of piping contents, can affect the safety of construction workers.
347	Pipes A	Mechanical	Piping	The design of piping materials and welds, and the identification of piping contents, can affect the safety of construction workers.
348	Pipes B	Mechanical	Piping	Piping systems which do not meet design code regulations and which are not designed for the appropriate construction conditions create safety hazards for construction workers.
349	Pipes B	Mechanical	Piping	Piping systems which do not meet design code regulations and which are not designed for the appropriate construction conditions create safety hazards for construction workers.
350	Pipes B	Mechanical	Piping	Piping systems which do not meet design code regulations and which are not designed for the appropriate construction conditions create safety hazards for construction workers.
351	Pipes B	Mechanical	Piping	Piping systems which do not meet design code regulations and which are not designed for the appropriate construction conditions create safety hazards for construction workers.
352	Pipes B	Mechanical	Piping	Piping systems which do not meet design code regulations and which are not designed for the appropriate construction conditions create safety hazards for construction workers.
353	Pipes C	Mechanical	Piping	Inadequate consideration of the entire piping system design can lead to safety hazards for construction workers.
354	Pipes C	Mechanical	Piping	Inadequate consideration of the entire piping system design can lead to safety hazards for construction workers.
355	Pipes C	Mechanical	Piping	Inadequate consideration of the entire piping system design can lead to safety hazards for construction workers.
356	Pipes C	Mechanical	Piping	Inadequate consideration of the entire piping system design can lead to safety hazards for construction workers.
357	Pipes C	Mechanical	Piping	Inadequate consideration of the entire piping system design can lead to safety hazards for construction workers.
358	Piping Location	Mechanical	Piping	The location of piping components throughout a project can affect the safety of construction workers.
359	Piping Location	Mechanical	Piping	The location of piping components throughout a project can affect the safety of construction workers.

360	Piping Location	Mechanical	Piping	The location of piping components throughout a project can affect the safety of construction workers.
361	Piping Location	Mechanical	Piping	The location of piping components throughout a project can affect the safety of construction workers.
362	Piping Supports	Mechanical	Piping	A lack of sufficient support for piping systems can create collapse and fall hazards for construction workers.
363	Piping Supports	Mechanical	Piping	A lack of sufficient support for piping systems can create collapse and fall hazards for construction workers.
364	Piping Supports	Mechanical	Piping	A lack of sufficient support for piping systems can create collapse and fall hazards for construction workers.
365	Piping Supports	Mechanical	Piping	A lack of sufficient support for piping systems can create collapse and fall hazards for construction workers.
366	Piping Supports	Mechanical	Piping	A lack of sufficient support for piping systems can create collapse and fall hazards for construction workers.
367	Piping Supports	Mechanical	Piping	A lack of sufficient support for piping systems can create collapse and fall hazards for construction workers.
368	Erection	Mechanical	Piping	Applying paint or insulation to elevated piping systems can lead to fall hazards for construction workers. Large pipe sections which lack adequate connection points for lifting, and lack restraint from rolling, can create safety hazards for workers durin
369	Erection	Mechanical	Piping	Applying paint or insulation to elevated piping systems can lead to fall hazards for construction workers. Large pipe sections which lack adequate connection points for lifting, and lack restraint from rolling, can create safety hazards for workers durin
370	Erection	Mechanical	Piping	Applying paint or insulation to elevated piping systems can lead to fall hazards for construction workers. Large pipe sections which lack adequate connection points for lifting, and lack restraint from rolling, can create safety hazards for workers durin
371	Existing Structure	Mechanical	Piping	Working with and connecting to existing piping systems presents safety hazards for construction workers.
372	Existing Structure	Mechanical	Piping	Working with and connecting to existing piping systems presents safety hazards for construction workers.
373	Existing Structure	Mechanical	Piping	Working with and connecting to existing piping systems presents safety hazards for construction workers.
374	Fire Hazards	Mechanical	Piping	The scheduled construction of new fire water systems, or demolition of existing systems, can lead to fire hazards on the construction project.

375	Fire Hazards	Mechanical	Piping	The scheduled construction of new fire water systems, or demolition of existing systems, can lead to fire hazards on the construction project.
376	Fire Hazards	Mechanical	Piping	The scheduled construction of new fire water systems, or demolition of existing systems, can lead to fire hazards on the construction project.
377	Testing	Mechanical	Piping	Piping material and system performance testing is essential to eliminate construction site safety hazards.
378	Testing	Mechanical	Piping	Piping material and system performance testing is essential to eliminate construction site safety hazards.
379	Testing	Mechanical	Piping	Piping material and system performance testing is essential to eliminate construction site safety hazards.
380	Testing	Mechanical	Piping	Piping material and system performance testing is essential to eliminate construction site safety hazards.
381	Underground Lines A	Mechanical	Piping	New and existing below-grade piping lines present hazards during excavation, pile driving, and drilling operations.
382	Underground Lines A	Mechanical	Piping	New and existing below-grade piping lines present hazards during excavation, pile driving, and drilling operations.
383	Underground Lines A	Mechanical	Piping	New and existing below-grade piping lines present hazards during excavation, pile driving, and drilling operations.
384	Underground Lines A	Mechanical	Piping	New and existing below-grade piping lines present hazards during excavation, pile driving, and drilling operations.
385	Underground Lines A	Mechanical	Piping	New and existing below-grade piping lines present hazards during excavation, pile driving, and drilling operations.
386	Underground Lines B	Mechanical	Piping	Existing underground lines which are in service during construction present safety hazards for construction workers.
387	Underground Lines B	Mechanical	Piping	Existing underground lines which are in service during construction present safety hazards for construction workers.
388	Underground Lines B	Mechanical	Piping	Existing underground lines which are in service during construction present safety hazards for construction workers.
389	Underground Lines B	Mechanical	Piping	Existing underground lines which are in service during construction present safety hazards for construction workers.
390	Underground Lines B	Mechanical	Piping	Existing underground lines which are in service during construction present safety hazards for construction workers.
391	Access	Civil	General Arrangement/Project Layout	Limited access to elevated walkways and platforms can prohibit timely response and efficient maneuverability into and out of the areas in emergency situations.
392	Electrical	Electrical; Civil	General Arrangement/Project Layout	The location and layout of electrical rooms, and the positioning of electrical controls, can create electrical shock and other safety hazards for construction & operations workers.

393	Electrical	Electrical	General Arrangement/Project Layout	The location and layout of electrical rooms, and the positioning of electrical controls, can create electrical shock and other safety hazards for construction & operations workers.
394	Electrical	Electrical; Civil	General Arrangement/Project Layout	The location and layout of electrical rooms, and the positioning of electrical controls, can create electrical shock and other safety hazards for construction & operations workers.
395	Emergency Access	Civil	General Arrangement/Project Layout	Emergency access to all parts of the project site is essential to provide prompt and adequate response to accidents and injuries.
396	Emergency Access	Civil	General Arrangement/Project Layout	Emergency access to all parts of the project site is essential to provide prompt and adequate response to accidents and injuries.
397	Floor Plan	Civil	General Arrangement/Project Layout	A building's floor plan can lead to fall hazards if there are numerous offsets of varying size, floor levels varying in size or shape, or if the size and layout does not meet local building codes.
398	Floor Plan	Civil	General Arrangement/Project Layout	A building's floor plan can lead to fall hazards if there are numerous offsets of varying size, floor levels varying in size or shape, or if the size and layout does not meet local building codes.
399	Floor Plan	Civil	General Arrangement/Project Layout	A building's floor plan can lead to fall hazards if there are numerous offsets of varying size, floor levels varying in size or shape, or if the size and layout does not meet local building codes.
400	Floor Plan	Civil	General Arrangement/Project Layout	A building's floor plan can lead to fall hazards if there are numerous offsets of varying size, floor levels varying in size or shape, or if the size and layout does not meet local building codes.
401	Materials	Civil; Mechanical; Electrical; I&C	General Arrangement/Project Layout	Construction materials can be hazardous to construction workers if the materials are flammable, contain toxic substances, or do not meet their specified use requirements.
402	Materials	Civil; Mechanical; Electrical; I&C	General Arrangement/Project Layout	Construction materials can be hazardous to construction workers if the materials are flammable, contain toxic substances, or do not meet their specified use requirements.
403	Materials	Civil; Mechanical; Electrical; I&C	General Arrangement/Project Layout	Construction materials can be hazardous to construction workers if the materials are flammable, contain toxic substances, or do not meet their specified use requirements.
404	Mechanical	Mechanical	General Arrangement/Project Layout	The location and layout of mechanical rooms, and the positioning of control valves and panels, can create obstruction and other safety hazards for construction workers.
405	Mechanical	Mechanical	General Arrangement/Project Layout	The location and layout of mechanical rooms, and the positioning of control valves and panels, can create obstruction and other safety hazards for construction workers.

406	Mechanical	Mechanical	General Arrangement/Project Layout	The location and layout of mechanical rooms, and the positioning of control valves and panels, can create obstruction and other safety hazards for construction workers.
407	Mechanical	Mechanical	General Arrangement/Project Layout	The location and layout of mechanical rooms, and the positioning of control valves and panels, can create obstruction and other safety hazards for construction workers.
408	Mechanical	Civil	General Arrangement/Project Layout	The location and layout of mechanical rooms, and the positioning of control valves and panels, can create obstruction and other safety hazards for construction workers.
409	Power Lines	Electrical; Civil	General Arrangement/Project Layout	Power lines which are in service during construction present an electrical shock hazard. Below-grade lines present a hazard when operating excavation, pile driving, and drilling equipment. Overhead lines are hazardous when operating cranes and other tal
410	Power Lines	Electrical; Civil	General Arrangement/Project Layout	Power lines which are in service during construction present an electrical shock hazard. Below-grade lines present a hazard when operating excavation, pile driving, and drilling equipment. Overhead lines are hazardous when operating cranes and other tal
411	Power Lines	Electrical; Civil	General Arrangement/Project Layout	Power lines which are in service during construction present an electrical shock hazard. Below-grade lines present a hazard when operating excavation, pile driving, and drilling equipment. Overhead lines are hazardous when operating cranes and other tal
412	Power Lines	Electrical; Civil	General Arrangement/Project Layout	Power lines which are in service during construction present an electrical shock hazard. Below-grade lines present a hazard when operating excavation, pile driving, and drilling equipment. Overhead lines are hazardous when operating cranes and other tal
413	Power Lines	Electrical; Civil	General Arrangement/Project Layout	Power lines which are in service during construction present an electrical shock hazard. Below-grade lines present a hazard when operating excavation, pile driving, and drilling equipment. Overhead lines are hazardous when operating cranes and other tal
414	Space Layout	Civil	General Arrangement/Project Layout	Rooms, walkways, platforms, etc. within a building which do not allow adequate egress or provide protection against hazardous materials can create safety hazards for construction workers.
415	Space Layout	Civil	General Arrangement/Project Layout	Rooms, walkways, platforms, etc. within a building which do not allow adequate egress or provide protection against hazardous materials can create safety hazards for construction workers.

416	Space Layout	Civil	General Arrangement/Project Layout	Rooms, walkways, platforms, etc. within a building which do not allow adequate egress or provide protection against hazardous materials can create safety hazards for construction workers.
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418	Space Layout	Civil	General Arrangement/Project Layout	Rooms, walkways, platforms, etc. within a building which do not allow adequate egress or provide protection against hazardous materials can create safety hazards for construction workers.
419	Space Layout	Civil	General Arrangement/Project Layout	Rooms, walkways, platforms, etc. within a building which do not allow adequate egress or provide protection against hazardous materials can create safety hazards for construction workers.
420	Stairs and Ramps	Civil	General Arrangement/Project Layout	Stairs and ramps which are exposed to the weather and isolated can lead to fall hazards for construction workers.
421	Stairs and Ramps	Civil	General Arrangement/Project Layout	Stairs and ramps which are exposed to the weather and isolated can lead to fall hazards for construction workers.
422	Stairs and Ramps	Civil	General Arrangement/Project Layout	Stairs and ramps which are exposed to the weather and isolated can lead to fall hazards for construction workers.
423	Vehicular Traffic	Civil	General Arrangement/Project Layout	Confined, congested, or sloped areas for contractor parking, material storage, and pedestrian access can lead to safety hazards for construction workers.
424	Vehicular Traffic	Civil	General Arrangement/Project Layout	Confined, congested, or sloped areas for contractor parking, material storage, and pedestrian access can lead to safety hazards for construction workers.
425	Vehicular Traffic	Civil	General Arrangement/Project Layout	Confined, congested, or sloped areas for contractor parking, material storage, and pedestrian access can lead to safety hazards for construction workers.
426	Vehicular Traffic	Civil	General Arrangement/Project Layout	Confined, congested, or sloped areas for contractor parking, material storage, and pedestrian access can lead to safety hazards for construction workers.
427	Excavations	Civil	General Arrangement/Project Layout	Inadequate clearance or congestion during excavation work can create cave-in and obstruction hazards for construction workers.
428	Excavations	Civil	General Arrangement/Project Layout	Inadequate clearance or congestion during excavation work can create cave-in and obstruction hazards for construction workers.
429	Excavations	Civil	General Arrangement/Project Layout	Inadequate clearance or congestion during excavation work can create cave-in and obstruction hazards for construction workers.

430	Excavations	Civil	General Arrangement/Project Layout	Inadequate clearance or congestion during excavation work can create cave-in and obstruction hazards for construction workers.
431	Openings	Civil	General Arrangement/Project Layout	General Arrangement/Project Layout: Openings
432	Openings	Civil	General Arrangement/Project Layout	General Arrangement/Project Layout: Openings
433	Openings	Civil	General Arrangement/Project Layout	General Arrangement/Project Layout: Openings
434	Openings	Civil	General Arrangement/Project Layout	General Arrangement/Project Layout: Openings
435	Road Design	Civil	Roads And Parking	Inadequate or congested traffic areas, and unstable road edges and shoulders, can lead to safety hazards for construction workers.
436	Road Design	Civil	Roads And Parking	Inadequate or congested traffic areas, and unstable road edges and shoulders, can lead to safety hazards for construction workers.
437	Road Design	Civil	Roads And Parking	Inadequate or congested traffic areas, and unstable road edges and shoulders, can lead to safety hazards for construction workers.
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442	Road Design	Civil	Roads And Parking	Inadequate or congested traffic areas, and unstable road edges and shoulders, can lead to safety hazards for construction workers.
443	Schedule/Sequence	Civil	Roads And Parking	Road construction, maintenance, and excavation operations can be hazardous for construction workers when working around existing utilities and ongoing public traffic.
444	Schedule/Sequence	Civil	Roads And Parking	Road construction, maintenance, and excavation operations can be hazardous for construction workers when working around existing utilities and ongoing public traffic.
445	Parking	Civil	Roads And Parking	The project schedule and work sequence can lead to safety hazards for construction workers.
446	Parking	Civil	Roads And Parking	The project schedule and work sequence can lead to safety hazards for construction workers.

447	Parking	Civil	Roads And Parking	The project schedule and work sequence can lead to safety hazards for construction workers.
448	Ladders	Civil	Stairs, Ladder, Ramp	The orientation and design of ladders with respect to the structure can create fall hazards for construction workers.
449	Ladders	Civil	Stairs, Ladder, Ramp	The orientation and design of ladders with respect to the structure can create fall hazards for construction workers.
450	Ladders	Civil	Stairs, Ladder, Ramp	The orientation and design of ladders with respect to the structure can create fall hazards for construction workers.
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453	Ladders	Civil	Stairs, Ladder, Ramp	The orientation and design of ladders with respect to the structure can create fall hazards for construction workers.
454	Ladders	Civil	Stairs, Ladder, Ramp	The orientation and design of ladders with respect to the structure can create fall hazards for construction workers.
455	Ladder - Rungs	Civil	Stairs, Ladder, Ramp	Ladder step or rung size, spacing, and materials can make ladders awkward to climb or slippery and create fall hazards for construction workers.
456	Ladder - Rungs	Civil	Stairs, Ladder, Ramp	Ladder step or rung size, spacing, and materials can make ladders awkward to climb or slippery and create fall hazards for construction workers.
457	Ladder - Rungs	Civil	Stairs, Ladder, Ramp	Ladder step or rung size, spacing, and materials can make ladders awkward to climb or slippery and create fall hazards for construction workers.
458	Ladder - Caged	Civil	Stairs, Ladder, Ramp	Inadequately designed ladder cages can create obstructions or snag construction worker clothing or equipment while climbing, and lead to construction workers falling.
459	Ladder - Caged	Civil	Stairs, Ladder, Ramp	Inadequately designed ladder cages can create obstructions or snag construction worker clothing or equipment while climbing, and lead to construction workers falling.
460	Ladder - Caged	Civil	Stairs, Ladder, Ramp	Inadequately designed ladder cages can create obstructions or snag construction worker clothing or equipment while climbing, and lead to construction workers falling.
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462	Ladder - Caged	Civil	Stairs, Ladder, Ramp	Inadequately designed ladder cages can create obstructions or snag construction worker clothing or equipment while climbing, and lead to construction workers falling.

463	Ladder - Cage Dimensions	Civil	Stairs, Ladder, Ramp	Ladder cages can create fall hazards for construction workers if they are too small, too large, or do not provide protection along the entire length of the ladder.
464	Ladder - Cage Dimensions	Civil	Stairs, Ladder, Ramp	Ladder cages can create fall hazards for construction workers if they are too small, too large, or do not provide protection along the entire length of the ladder.
465	Ladder - Cage Dimensions	Civil	Stairs, Ladder, Ramp	Ladder cages can create fall hazards for construction workers if they are too small, too large, or do not provide protection along the entire length of the ladder.
466	Ladder - Length	Civil	Stairs, Ladder, Ramp	Ladder lengths can affect a construction worker's risk of falling if the ladders are long and do not provide a rest area, or if they do not extend above the top landing.
467	Ladder - Length	Civil	Stairs, Ladder, Ramp	Ladder lengths can affect a construction worker's risk of falling if the ladders are long and do not provide a rest area, or if they do not extend above the top landing.
468	Ladder - Clearance	Civil	Stairs, Ladder, Ramp	Ladders which have attachments or other objects adjacent to the climbing area can obstruct workers during climbing and create a fall hazard.
469	Ladder - Clearance	Civil	Stairs, Ladder, Ramp	Ladders which have attachments or other objects adjacent to the climbing area can obstruct workers during climbing and create a fall hazard.
470	Ladder - Clearance	Civil	Stairs, Ladder, Ramp	Ladders which have attachments or other objects adjacent to the climbing area can obstruct workers during climbing and create a fall hazard.
471	Ladder - Loads	Civil	Stairs, Ladder, Ramp	Ladders which are not designed to withstand construction loading can collapse and lead to construction workers falling.
472	Ladder - Loads	Civil	Stairs, Ladder, Ramp	Ladders which are not designed to withstand construction loading can collapse and lead to construction workers falling.
473	Ladder - Loads	Civil	Stairs, Ladder, Ramp	Ladders which are not designed to withstand construction loading can collapse and lead to construction workers falling.
474	Ladders vs Stairs	Civil	Stairs, Ladder, Ramp	Frequent use of ladders by construction and maintenance workers to move material and equipment increases the possibility of falling from the ladders.
475	Ramps	Civil	Stairs, Ladder, Ramp	Ramps which do not contain any slip resistance measures or are subject to water, snow, or ice can be a falling hazard for construction workers.
476	Ramps	Civil	Stairs, Ladder, Ramp	Ramps which do not contain any slip resistance measures or are subject to water, snow, or ice can be a falling hazard for construction workers.
477	Ramps	Civil	Stairs, Ladder, Ramp	Ramps which do not contain any slip resistance measures or are subject to water, snow, or ice can be a falling hazard for construction workers.

478	Ramps	Civil	Stairs, Ladder, Ramp	Ramps which do not contain any slip resistance measures or are subject to water, snow, or ice can be a falling hazard for construction workers.
479	Stairs	Civil	Stairs, Ladder, Ramp	A lack of uniform stairway slopes and stair dimensions throughout a project can lead to construction workers tripping or falling due to unanticipated stairway layouts.
480	Stairs	Civil	Stairs, Ladder, Ramp	A lack of uniform stairway slopes and stair dimensions throughout a project can lead to construction workers tripping or falling due to unanticipated stairway layouts.
481	Stairs	Civil	Stairs, Ladder, Ramp	A lack of uniform stairway slopes and stair dimensions throughout a project can lead to construction workers tripping or falling due to unanticipated stairway layouts.
482	Stair Landings	Civil	Stairs, Ladder, Ramp	Inadequate, misplaced, or obstructed stairway landings can lead to falls when stepping onto or off of a stairway.
483	Stair Landings	Civil	Stairs, Ladder, Ramp	Inadequate, misplaced, or obstructed stairway landings can lead to falls when stepping onto or off of a stairway.
484	Stair Landings	Civil	Stairs, Ladder, Ramp	Inadequate, misplaced, or obstructed stairway landings can lead to falls when stepping onto or off of a stairway.
485	Stair Landings	Civil	Stairs, Ladder, Ramp	Inadequate, misplaced, or obstructed stairway landings can lead to falls when stepping onto or off of a stairway.
486	Stair Materials	Civil	Stairs, Ladder, Ramp	Stairway materials should be selected with consideration of the anticipated construction work area and surrounding environmental conditions to minimize deterioration of the stairways and the possibility of falling.
487	Stair Materials	Civil	Stairs, Ladder, Ramp	Stairway materials should be selected with consideration of the anticipated construction work area and surrounding environmental conditions to minimize deterioration of the stairways and the possibility of falling.
488	Stair Materials	Civil	Stairs, Ladder, Ramp	Stairway materials should be selected with consideration of the anticipated construction work area and surrounding environmental conditions to minimize deterioration of the stairways and the possibility of falling.
489	Stair Materials	Civil	Stairs, Ladder, Ramp	Stairway materials should be selected with consideration of the anticipated construction work area and surrounding environmental conditions to minimize deterioration of the stairways and the possibility of falling.
490	Stair Location	Civil	Stairs, Ladder, Ramp	Exposed or narrow stairways can create climbing problems for construction workers carrying materials or equipment and lead to falls.
491	Stair Location	Civil	Stairs, Ladder, Ramp	Exposed or narrow stairways can create climbing problems for construction workers carrying materials or equipment and lead to falls.
492	Stair Location	Civil	Stairs, Ladder, Ramp	Exposed or narrow stairways can create climbing problems for construction workers carrying materials or equipment and lead to falls.

493	Stair Railing	Civil	Stairs, Ladder, Ramp	Stairways with inadequate or non-existent handrails or stairrails can create fall hazards for construction workers.
494	Stair Erection	Civil	Stairs, Ladder, Ramp	To get to elevated work areas prior to erection of permanent stairways, construction workers must use temporary stairways, ladders, or manlifts which are often unstable, inadequately designed, or damaged.
495	Steel Beam, Purlins, Girts, Utility Bridge, Bent form Plate	Civil	Structural Steel Framing	Hazzards associated with steel erection can be reduced or eliminated by following the requirements on OSHA 1926 Subpart R.
496	Steel Beam, Purlins, Girts, Utility Bridge, Bent form Plate	Civil	Structural Steel Framing	Hazzards associated with steel erection can be reduced or eliminated by following the requirements on OSHA 1926 Subpart R.
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518	Steel Beam, Purlins, Girts, Utility Bridge, Bent form Plate	Civil	Structural Steel Framing	Hazzards associated with steel erection can be reduced or eliminated by following the requirements on OSHA 1926 Subpart R.
519	Steel Column & Vertical Bracing	Civil; Mechanical	Structural Steel Framing	Tall steel structures can easily collapse during the erection process if the steel is not adequately supported before it is permanently bolted or welded into place.

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528	Steel Column & Vertical Bracing	Civil	Structural Steel Framing	Tall steel structures can easily collapse during the erection process if the steel is not adequately supported before it is permanently bolted or welded into place.
529	High Strength Bolts	Civil	Structural Steel Framing	Complicated or non-standard connections can lead to confusion and mis-installation of bolts and washers.
530	High Strength Bolts	Civil	Structural Steel Framing	Complicated or non-standard connections can lead to confusion and mis-installation of bolts and washers.
531	Miscellaneous Steel, Railing and Grating	Civil	Structural Steel Framing	Structural steel erection operations can lead to collapse if adequate support is not provided for the members before permanent connection. Welding operations can create fire hazards due to excessive slag or sparks, and also expose construction workers to
532	Miscellaneous Steel, Railing and Grating	Civil	Structural Steel Framing	Structural steel erection operations can lead to collapse if adequate support is not provided for the members before permanent connection. Welding operations can create fire hazards due to excessive slag or sparks, and also expose construction workers to

533	Miscellaneous Steel, Railing and Grating	Civil	Structural Steel Framing	Structural steel erection operations can lead to collapse if adequate support is not provided for the members before permanent connection. Welding operations can create fire hazards due to excessive slag or sparks, and also expose construction workers to
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545	Miscellaneous Steel, Railing and Grating	Civil	Structural Steel Framing	Structural steel erection operations can lead to collapse if adequate support is not provided for the members before permanent connection. Welding operations can create fire hazards due to excessive slag or sparks, and also expose construction workers to
546	Miscellaneous Steel, Railing and Grating	Civil	Structural Steel Framing	Structural steel erection operations can lead to collapse if adequate support is not provided for the members before permanent connection. Welding operations can create fire hazards due to excessive slag or sparks, and also expose construction workers to
547	Miscellaneous Steel, Railing and Grating	Civil	Structural Steel Framing	Structural steel erection operations can lead to collapse if adequate support is not provided for the members before permanent connection. Welding operations can create fire hazards due to excessive slag or sparks, and also expose construction workers to
548	Roof and Floor Decking	Civil	Structural Steel Framing	Iron workers placing decking can expose themselves to a fall hazard.
549	Roof and Floor Decking	Civil	Structural Steel Framing	Iron workers placing decking can expose themselves to a fall hazard.
550	Roof and Floor Decking	Civil	Structural Steel Framing	Iron workers placing decking can expose themselves to a fall hazard.
551	Roof and Floor Decking	Civil	Structural Steel Framing	Iron workers placing decking can expose themselves to a fall hazard.
552	Roof and Floor Decking	Civil	Structural Steel Framing	Iron workers placing decking can expose themselves to a fall hazard.
553	Roof and Floor Decking	Civil	Structural Steel Framing	Iron workers placing decking can expose themselves to a fall hazard.

554	Roof and Floor Decking	Civil	Structural Steel Framing	Iron workers placing decking can expose themselves to a fall hazard.
555	Roof and Floor Decking	Civil	Structural Steel Framing	Iron workers placing decking can expose themselves to a fall hazard.
556	Roof and Floor Decking	Civil	Structural Steel Framing	Iron workers placing decking can expose themselves to a fall hazard.
557	Platforms/Walkways	Civil	Structural Steel Framing	Structural Steel Framing: Platforms/Walkways
558	Platforms/Walkways	Civil	Structural Steel Framing	Structural Steel Framing: Platforms/Walkways
559	Platforms/Walkways	Civil	Structural Steel Framing	Structural Steel Framing: Platforms/Walkways
560	Platforms/Walkways	Civil	Structural Steel Framing	Structural Steel Framing: Platforms/Walkways
561	Platforms/Walkways	Civil	Structural Steel Framing	Structural Steel Framing: Platforms/Walkways
562	Platforms/Walkways	Civil	Structural Steel Framing	Structural Steel Framing: Platforms/Walkways
563	Ductwork: Demolition and Modification of Existing	Civil	Structural Steel Framing	Never assume the erector will use sound judgement when domolishing existing ductwork.
564	Ductwork: Demolition and Modification of Existing	Civil	Structural Steel Framing	Never assume the erector will use sound judgement when domolishing existing ductwork.
565	Ductwork: Demolition and Modification of Existing	Civil	Structural Steel Framing	Never assume the erector will use sound judgement when domolishing existing ductwork.
566	Ductwork: Demolition and Modification of Existing	Civil	Structural Steel Framing	Never assume the erector will use sound judgement when domolishing existing ductwork.
567	Ductwork: Preservation and Strengthening of Existing	Civil	Structural Steel Framing	Existing ductwork will normally be in poor condition.
568	Ductwork: Preservation and Strengthening of Existing	Civil	Structural Steel Framing	Existing ductwork will normally be in poor condition.
569	Ductwork: Preservation and Strengthening of Existing	Civil	Structural Steel Framing	Existing ductwork will normally be in poor condition.

570	Ductwork: Preservation and Strengthening of Existing	Civil	Structural Steel Framing	Existing ductwork will normally be in poor condition.
571	Ductwork: Preservation and Strengthening of Existing	Civil	Structural Steel Framing	Existing ductwork will normally be in poor condition.
572	Ductwork: Preservation and Strengthening of Existing	Civil	Structural Steel Framing	Existing ductwork will normally be in poor condition.
573	Ductwork: Preservation and Strengthening of Existing	Civil	Structural Steel Framing	Existing ductwork will normally be in poor condition.
574	Ductwork: Construction Friendly Design	Civil	Structural Steel Framing	Remember to keep it simple.
575	Ductwork: Construction Friendly Design	Civil	Structural Steel Framing	Remember to keep it simple.
576	Ductwork: Construction Friendly Design	Civil	Structural Steel Framing	Remember to keep it simple.
577	Ductwork: Construction Friendly Design	Civil	Structural Steel Framing	Remember to keep it simple.
578	Ductwork: Construction Friendly Design	Civil	Structural Steel Framing	Remember to keep it simple.
579	Ductwork: Construction Friendly Design	Civil	Structural Steel Framing	Remember to keep it simple.
580	Ductwork: Construction Friendly Design	Civil	Structural Steel Framing	Remember to keep it simple.
581	Ductwork: Construction Friendly Design	Civil	Structural Steel Framing	Remember to keep it simple.
582	Ductwork: Construction Friendly Design	Civil	Structural Steel Framing	Remember to keep it simple.
583	Ductwork: Construction Friendly Design	Civil	Structural Steel Framing	Remember to keep it simple.
584	Ductwork: Construction Friendly Design	Civil	Structural Steel Framing	Remember to keep it simple.
585	Ductwork: Construction Friendly Design	Civil	Structural Steel Framing	Remember to keep it simple.
586	Ductwork: Construction Friendly Design	Civil	Structural Steel Framing	Remember to keep it simple.
587	Ductwork: Construction Friendly Design	Civil	Structural Steel Framing	Remember to keep it simple.

588	Ductwork: Construction Friendly Design	Civil	Structural Steel Framing	Remember to keep it simple.
589	Ductwork: Construction Friendly Design	Civil	Structural Steel Framing	Remember to keep it simple.
590	Ductwork: Construction Friendly Design	Civil	Structural Steel Framing	Remember to keep it simple.
591	Ductwork: Construction Friendly Design	Civil	Structural Steel Framing	Remember to keep it simple.
592	Ductwork: Construction Friendly Design	Civil	Structural Steel Framing	Remember to keep it simple.
593	Ductwork: Construction Friendly Design	Civil	Structural Steel Framing	Remember to keep it simple.
594	Ductwork: Construction Friendly Design	Civil	Structural Steel Framing	Remember to keep it simple.
595	Ductwork: Construction Friendly Design	Civil	Structural Steel Framing	Remember to keep it simple.
596	Hazardous Conditions	Mechanical	Tank, Vessel	Tanks can present confined space, toxic substance, fire, and explosion hazards for construction workers.
597	Hazardous Conditions	Mechanical	Tank, Vessel	Tanks can present confined space, toxic substance, fire, and explosion hazards for construction workers.
598	Hazardous Conditions	Mechanical	Tank, Vessel	Tanks can present confined space, toxic substance, fire, and explosion hazards for construction workers.
599	Hazardous Conditions	Mechanical	Tank, Vessel	Tanks can present confined space, toxic substance, fire, and explosion hazards for construction workers.
600	Hazardous Conditions	Mechanical	Tank, Vessel	Tanks can present confined space, toxic substance, fire, and explosion hazards for construction workers.
601	Tank Erection	Civil; Mechanical	Tank, Vessel	The erection and/or placement process used for tanks and vessels can lead to safety hazards for construction workers.
602	Tank Erection	Civil; Mechanical	Tank, Vessel	The erection and/or placement process used for tanks and vessels can lead to safety hazards for construction workers.
603	Tank Erection	Civil; Mechanical	Tank, Vessel	The erection and/or placement process used for tanks and vessels can lead to safety hazards for construction workers.
604	Tank Erection	Civil; Mechanical	Tank, Vessel	The erection and/or placement process used for tanks and vessels can lead to safety hazards for construction workers.
605	Underground Tanks	Civil; Mechanical	Tank, Vessel	Underground tanks and vessels which are not adequately protected can be safety hazards for construction workers.
606	Tank Entrances	Mechanical	Tank, Vessel	Without adequate entrances and ventilation, tanks and vessels can create confined space hazards.
607	Tank Entrances	Mechanical	Tank, Vessel	Without adequate entrances and ventilation, tanks and vessels can create confined space hazards.
608	Tank Entrances	Mechanical	Tank, Vessel	Without adequate entrances and ventilation, tanks and vessels can create confined space hazards.

609	Tank Entrances	Mechanical	Tank, Vessel	Without adequate entrances and ventilation, tanks and vessels can create confined space hazards.
610	Tank Stairs	Civil; Mechanical	Tank, Vessel	The design of stairs for large tanks and vessels can lead to fall hazards for construction workers.
611	Tank Stairs	Civil; Mechanical	Tank, Vessel	The design of stairs for large tanks and vessels can lead to fall hazards for construction workers.
612	Designs	Civil	Constructability	Without adequate knowledge of the project design concept, complicated or unique designs can lead to construction site hazards.
613	Designs	Civil	Constructability	Without adequate knowledge of the project design concept, complicated or unique designs can lead to construction site hazards.
614	Fire Hazards	Civil; Mechanical	Constructability	The scheduled construction or demolition of fire prevention devices can lead to fire hazards for construction workers.
615	Fire Hazards	Civil; Mechanical	Constructability	The scheduled construction or demolition of fire prevention devices can lead to fire hazards for construction workers.
616	Fire Hazards	Civil; Mechanical	Constructability	The scheduled construction or demolition of fire prevention devices can lead to fire hazards for construction workers.
617	Roadways	Civil	Constructability	The work schedule and construction sequence for plant road construction and maintenance can affect the safety of construction workers.
618	Roadways	Civil	Constructability	The work schedule and construction sequence for plant road construction and maintenance can affect the safety of construction workers.
619	Stairways	Civil	Constructability	Timely erection of permanent stairways and handrails can help eliminate falls and other hazards associated with temporary stairs and scaffolding.
620	Stairways	Civil	Constructability	Timely erection of permanent stairways and handrails can help eliminate falls and other hazards associated with temporary stairs and scaffolding.
621	Workers	Civil	Constructability	Construction schedules can affect worker safety and health if the schedules do not allow for sufficient safety planning and recognize worker health requirements.
622	Electrical	Electrical	Constructability	The scheduled construction of electrical lines and equipment can lead to safety hazards for construction workers.
623	Electrical	Electrical	Constructability	The scheduled construction of electrical lines and equipment can lead to safety hazards for construction workers.
624	Electrical	Electrical	Constructability	The scheduled construction of electrical lines and equipment can lead to safety hazards for construction workers.
625	Electrical	Electrical	Constructability	The scheduled construction of electrical lines and equipment can lead to safety hazards for construction workers.
626	Elevated Work	Civil	Constructability	The work schedule and construction sequence for work performed at elevated levels can affect the safety of construction workers.

627	Elevated Work	Civil	Constructability	The work schedule and construction sequence for work performed at elevated levels can affect the safety of construction workers.
628	Existing Structure	Civil	Constructability	The work schedule and sequence for projects which require work with an existing structure or utilities can lead to safety hazards for construction workers.
629	Existing Structure	Civil	Constructability	The work schedule and sequence for projects which require work with an existing structure or utilities can lead to safety hazards for construction workers.
630	Mechanical/HVAC	Mechanical	Constructability	The scheduled construction of mechanical and HVAC equipment can lead to safety hazards for construction workers.
631	Mechanical/HVAC	Mechanical	Constructability	The scheduled construction of mechanical and HVAC equipment can lead to safety hazards for construction workers.
632	Mechanical/HVAC	Civil	Constructability	The scheduled construction of mechanical and HVAC equipment can lead to safety hazards for construction workers.
633	Testing	Civil	Constructability	Timely testing of new construction materials and work in place can eliminate safety hazards for construction workers.
634	Testing	Civil	Constructability	Timely testing of new construction materials and work in place can eliminate safety hazards for construction workers.
635	Existing Structure	Civil	Existing Buildings	Working with an existing structure can lead to collapse hazards if the constructor lacks knowledge of the existing structure's loading conditions and structural integrity.
636	Existing Structure	Civil	Existing Buildings	Working with an existing structure can lead to collapse hazards if the constructor lacks knowledge of the existing structure's loading conditions and structural integrity.
637	Existing Structure	Civil	Existing Buildings	Working with an existing structure can lead to collapse hazards if the constructor lacks knowledge of the existing structure's loading conditions and structural integrity.
638	Existing Structure	Civil	Existing Buildings	Working with an existing structure can lead to collapse hazards if the constructor lacks knowledge of the existing structure's loading conditions and structural integrity.
639	Existing Structure	Civil	Existing Buildings	Working with an existing structure can lead to collapse hazards if the constructor lacks knowledge of the existing structure's loading conditions and structural integrity.
640	Existing Structure	Civil	Existing Buildings	Working with an existing structure can lead to collapse hazards if the constructor lacks knowledge of the existing structure's loading conditions and structural integrity.
641	Utilities	Civil	Existing Buildings	A lack of access to or knowledge of existing utilities can affect the safety of construction workers in emergency situations and during excavation operations.

642	Utilities	Civil	Existing Buildings	A lack of access to or knowledge of existing utilities can affect the safety of construction workers in emergency situations and during excavation operations.
643	Utilities	Civil	Existing Buildings	A lack of access to or knowledge of existing utilities can affect the safety of construction workers in emergency situations and during excavation operations.
644	Utilities	Civil	Existing Buildings	A lack of access to or knowledge of existing utilities can affect the safety of construction workers in emergency situations and during excavation operations.
645	Fire Hazards	Civil	Existing Buildings	Structures which contain or are constructed of combustible materials can be fire hazards during the construction phase.
646	Demolition	Civil	Existing Buildings	Plan what the demolition documents will look like and who will be responsible for the documents.
647	Demolition	Civil	Existing Buildings	Plan what the demolition documents will look like and who will be responsible for the documents.
648	Demolition	Civil	Existing Buildings	Plan what the demolition documents will look like and who will be responsible for the documents.
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653	Demolition	Civil	Existing Buildings	Plan what the demolition documents will look like and who will be responsible for the documents.
654	Area Classification	I&C	I&C	Ensure instrument/devices located in hazardous areas meet design requirements for that area.
655	Area Classification	I&C	I&C	Ensure instrument/devices located in hazardous areas meet design requirements for that area.
656	Area Classification	I&C	I&C	Ensure instrument/devices located in hazardous areas meet design requirements for that area.
657	Area Classification	I&C	I&C	Ensure instrument/devices located in hazardous areas meet design requirements for that area.
658	Design	I&C	I&C	Codes, Standards, Requirements and Performance
659	Design	I&C	I&C	Codes, Standards, Requirements and Performance
660	Design	I&C	I&C	Codes, Standards, Requirements and Performance

661	Design	I&C	I&C	Codes, Standards, Requirements and Performance
662	Design	I&C	I&C	Codes, Standards, Requirements and Performance
663	Design	I&C	I&C	Codes, Standards, Requirements and Performance
664	Design	I&C	I&C	Codes, Standards, Requirements and Performance
665	Design	I&C	I&C	Codes, Standards, Requirements and Performance
666	Design	I&C	I&C	Codes, Standards, Requirements and Performance
667	Design	I&C	I&C	Codes, Standards, Requirements and Performance
668	Design	I&C	I&C	Codes, Standards, Requirements and Performance
669	Design	I&C	I&C	Codes, Standards, Requirements and Performance
670	Design	I&C	I&C	Codes, Standards, Requirements and Performance
671	Design	I&C	I&C	Codes, Standards, Requirements and Performance
672	Design	I&C	I&C	Codes, Standards, Requirements and Performance
673	Design	I&C	I&C	Codes, Standards, Requirements and Performance
674	Design	I&C	I&C	Codes, Standards, Requirements and Performance
675	Design	I&C	I&C	Codes, Standards, Requirements and Performance
676	Design	I&C	I&C	Codes, Standards, Requirements and Performance
677	Design	I&C	I&C	Codes, Standards, Requirements and Performance

678	Compatibility	I&C	I&C	Process and Codes & Standards Compatible
679	Compatibility	I&C	I&C	Process and Codes & Standards Compatible
680	Construction	I&C	I&C	Deliverables, Procurement and Support Schedules
681	Construction	I&C	I&C	Deliverables, Procurement and Support Schedules
682	Construction	I&C	I&C	Deliverables, Procurement and Support Schedules
683	Communication	I&C	I&C	OIS and GENGuard Communication
684	Communication	I&C	I&C	OIS and GENGuard Communication
685	Controls	I&C	I&C	Codes, Standards, Requirements and Performance
686	Controls	I&C	I&C	Codes, Standards, Requirements and Performance
687	Controls	I&C	I&C	Codes, Standards, Requirements and Performance
688	Controls	I&C	I&C	Codes, Standards, Requirements and Performance
689	Controls	I&C	I&C	Codes, Standards, Requirements and Performance
690	Controls	I&C	I&C	Codes, Standards, Requirements and Performance
691	Controls	I&C	I&C	Codes, Standards, Requirements and Performance
692	Controls	I&C	I&C	Codes, Standards, Requirements and Performance
693	Controls	I&C	I&C	Codes, Standards, Requirements and Performance
694	Controls	I&C	I&C	Codes, Standards, Requirements and Performance
695	Controls	I&C	I&C	Codes, Standards, Requirements and Performance

696	Controls	I&C	I&C	Codes, Standards, Requirements and Performance
697	Electrical	I&C	I&C	Instruments & Controls Electrical Design Requirements.
698	Electrical	I&C	I&C	Instruments & Controls Electrical Design Requirements.
699	Electrical	I&C	I&C	Instruments & Controls Electrical Design Requirements.
700	Electrical	I&C	I&C	Instruments & Controls Electrical Design Requirements.
701	Electrical	I&C	I&C	Instruments & Controls Electrical Design Requirements.
702	Electrical	I&C	I&C	Instruments & Controls Electrical Design Requirements.
703	Electrical	I&C	I&C	Instruments & Controls Electrical Design Requirements.
704	Elevated Work	I&C	I&C	Assembly and Supports.
705	Elevated Work	I&C	I&C	Assembly and Supports.
706	Enclosures	I&C	I&C	Instrument Enclosures must meet environmental conditions.
707	Enclosures	I&C	I&C	Instrument Enclosures must meet environmental conditions.
708	Existing	I&C	I&C	Interacting with existing equipment requires extra attention.
709	Existing	I&C	I&C	Interacting with existing equipment requires extra attention.
710	Existing	I&C	I&C	Interacting with existing equipment requires extra attention.
711	Existing	I&C	I&C	Interacting with existing equipment requires extra attention.
712	Existing	I&C	I&C	Interacting with existing equipment requires extra attention.
713	Existing	I&C	I&C	Interacting with existing equipment requires extra attention.
714	Fire Hazards	I&C	I&C	Avoid potential fire harzards and exit obstructions.
715	Fire Hazards	I&C	I&C	Avoid potential fire harzards and exit obstructions.
716	Freeze Protection	I&C	I&C	Freeze protection notification for project requirements.
717	Freeze Protection	I&C	I&C	Freeze protection notification for project requirements.

718	Freeze Protection	I&C	I&C	Freeze protection notification for project requirements.
719	Freeze Protection	I&C	I&C	Freeze protection notification for project requirements.
720	Grounding	I&C	I&C	Ground devices at only one point to avoid a ground loop issue.
721	Installation	I&C	I&C	Ensure that adequate information is available on project drawings to avoid installation problems and issues
722	Lightning Protection	I&C	I&C	Lightning Codes and Standards.
723	Lightning Protection	I&C	I&C	Lightning Codes and Standards.
724	Location	I&C	I&C	Instruments must meet area classifications, be accessible, be visible, and avoid interference hazards.
725	Location	I&C	I&C	Instruments must meet area classifications, be accessible, be visible, and avoid interference hazards.
726	Location	I&C	I&C	Instruments must meet area classifications, be accessible, be visible, and avoid interference hazards.
727	Location	I&C	I&C	Instruments must meet area classifications, be accessible, be visible, and avoid interference hazards.
728	Location	I&C	I&C	Instruments must meet area classifications, be accessible, be visible, and avoid interference hazards.
729	Location	I&C	I&C	Instruments must meet area classifications, be accessible, be visible, and avoid interference hazards.
730	Location	I&C	I&C	Instruments must meet area classifications, be accessible, be visible, and avoid interference hazards.
731	Location	I&C	I&C	Instruments must meet area classifications, be accessible, be visible, and avoid interference hazards.
732	Location	I&C	I&C	Instruments must meet area classifications, be accessible, be visible, and avoid interference hazards.
733	Materials	I&C	I&C	Instruments must meet project compatibility standards.
734	Materials	I&C	I&C	Instruments must meet project compatibility standards.
735	Materials	I&C	I&C	Instruments must meet project compatibility standards.

736	Materials	I&C	I&C	Instruments must meet project compatibility standards.
737	Mechanical	I&C	I&C	Root Valves connections must be compatible with instrument connections.
738	Package Supplied Units	I&C	I&C	Vendor supplied equipment must be project specific and be maintianed.
739	Package Supplied Units	I&C	I&C	Vendor supplied equipment must be project specific and be maintianed.
740	Panels	I&C	I&C	New and existing panels and consoles must be in compliances with project scope and requirements.
741	Panels	I&C	I&C	New and existing panels and consoles must be in compliances with project scope and requirements.
742	Piping	I&C	I&C	Avoid thermal problems with piping and tubing expansion.
743	Piping	I&C	I&C	Avoid thermal problems with piping and tubing expansion.
744	Piping	I&C	I&C	Avoid thermal problems with piping and tubing expansion.
745	Piping	I&C	I&C	Avoid thermal problems with piping and tubing expansion.
746	Power	I&C	I&C	Communicate power requirements as soon as possible.
747	Process Conditions	I&C	I&C	Instrument and controls compatibility.
748	Process Conditions	I&C	I&C	Instrument and controls compatibility.
749	Process Hazard Analysis (PHA)	I&C	I&C	Document Process Hazard Analysis.
750	Safety	I&C	I&C	Review Personal Protective Equipment.
751	Safety	I&C	I&C	Review Personal Protective Equipment.
752	Safety	I&C	I&C	Review Personal Protective Equipment.
753	Safety	I&C	I&C	Review Personal Protective Equipment.
754	Safety	I&C	I&C	Review Personal Protective Equipment.
755	Site Hazards	I&C	I&C	Ensure that individuals are aware of any potential site hazard.
756	Site Hazards	I&C	I&C	Ensure that individuals are aware of any potential site hazard.
757	Site Hazards	I&C	I&C	Ensure that individuals are aware of any potential site hazard.
758	Supports	I&C	I&C	Instrument supports to structural steel.

759	Supports	I&C	I&C	Instrument supports to structural steel.
760	Supports	I&C	I&C	Instrument supports to structural steel.
761	Testing	I&C	I&C	Test equipment and tools, procedures, reports and test connections.
762	Testing	I&C	I&C	Test equipment and tools, procedures, reports and test connections.
763	Testing	I&C	I&C	Test equipment and tools, procedures, reports and test connections.
764	Testing	I&C	I&C	Test equipment and tools, procedures, reports and test connections.
765	Tubing	I&C	I&C	Instrument tubing issues.
766	Tubing	I&C	I&C	Instrument tubing issues.
767	Tubing	I&C	I&C	Instrument tubing issues.
768	Tubing	I&C	I&C	Instrument tubing issues.
769	Tubing	I&C	I&C	Instrument tubing issues.
770	Tubing	I&C	I&C	Instrument tubing issues.
771	Tubing	I&C	I&C	Instrument tubing issues.
772	Tubing	I&C	I&C	Instrument tubing issues.
773	Tubing	I&C	I&C	Instrument tubing issues.
774	Tubing	I&C	I&C	Instrument tubing issues.
775	Valves	I&C	I&C	Root valves, blow-down valves, control valves and compatibility.
776	Valves	I&C	I&C	Root valves, blow-down valves, control valves and compatibility.
777	Valves	I&C	I&C	Root valves, blow-down valves, control valves and compatibility.
778	Valves	I&C	I&C	Root valves, blow-down valves, control valves and compatibility.
779	Testing	Civil; Mechanical	Concrete	Timely testing of materials, structural members, and project systems is essential to prevent collapse of the structure or injury during construction.
780	Testing	Civil; Mechanical	Concrete	Timely testing of materials, structural members, and project systems is essential to prevent collapse of the structure or injury during construction.

781	Testing	Civil; Mechanical	Concrete	Timely testing of materials, structural members, and project systems is essential to prevent collapse of the structure or injury during construction.
782	Caissons	Civil	Concrete	Pile foundation systems which are not designed with consideration of the soil conditions and pile driving equipment can lead to cave-in and other hazards for construction workers.
783	Caissons	Civil	Concrete	Pile foundation systems which are not designed with consideration of the soil conditions and pile driving equipment can lead to cave-in and other hazards for construction workers.
784	Caissons	Civil	Concrete	Pile foundation systems which are not designed with consideration of the soil conditions and pile driving equipment can lead to cave-in and other hazards for construction workers.
785	Caissons	Civil	Concrete	Pile foundation systems which are not designed with consideration of the soil conditions and pile driving equipment can lead to cave-in and other hazards for construction workers.
786	Foundations	Civil	Concrete	Footing location and reinforcing steel can create collapse, tripping, and fall hazards for construction workers during the construction of the foundation.
787	Foundations	Civil	Concrete	Footing location and reinforcing steel can create collapse, tripping, and fall hazards for construction workers during the construction of the foundation.
788	Foundations	Civil	Concrete	Footing location and reinforcing steel can create collapse, tripping, and fall hazards for construction workers during the construction of the foundation.
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809	Foundations	Civil	Concrete	Footing location and reinforcing steel can create collapse, tripping, and fall hazards for construction workers during the construction of the foundation.
810	Foundations	Civil	Concrete	Footing location and reinforcing steel can create collapse, tripping, and fall hazards for construction workers during the construction of the foundation.
811	Foundations	Civil	Concrete	Footing location and reinforcing steel can create collapse, tripping, and fall hazards for construction workers during the construction of the foundation.
812	Slab On Grade	Civil	Concrete	Concrete floor finishes and concrete stairway and ladder landings should be designed to prevent falls and obstructions..
813	Slab On Grade	Civil	Concrete	Concrete floor finishes and concrete stairway and ladder landings should be designed to prevent falls and obstructions..
814	Slab On Grade	Civil	Concrete	Concrete floor finishes and concrete stairway and ladder landings should be designed to prevent falls and obstructions..
815	Slab On Grade	Civil	Concrete	Concrete floor finishes and concrete stairway and ladder landings should be designed to prevent falls and obstructions..
816	Slab On Grade	Civil	Concrete	Concrete floor finishes and concrete stairway and ladder landings should be designed to prevent falls and obstructions..
817	Slab On Grade	Civil	Concrete	Concrete floor finishes and concrete stairway and ladder landings should be designed to prevent falls and obstructions..
818	Slab On Grade	Civil; Mechanical	Concrete	Concrete floor finishes and concrete stairway and ladder landings should be designed to prevent falls and obstructions..
819	Slab On Grade	Civil; Mechanical	Concrete	Concrete floor finishes and concrete stairway and ladder landings should be designed to prevent falls and obstructions..
820	Slab On Grade	Civil; Mechanical	Concrete	Concrete floor finishes and concrete stairway and ladder landings should be designed to prevent falls and obstructions..
821	Slab On Grade	Civil	Concrete	Concrete floor finishes and concrete stairway and ladder landings should be designed to prevent falls and obstructions..
822	Slab On Grade	Civil	Concrete	Concrete floor finishes and concrete stairway and ladder landings should be designed to prevent falls and obstructions..

823	Slab On Grade	Civil	Concrete	Concrete floor finishes and concrete stairway and ladder landings should be designed to prevent falls and obstructions..
824	Slab On Grade	Civil	Concrete	Concrete floor finishes and concrete stairway and ladder landings should be designed to prevent falls and obstructions..
825	Slab On Grade	Civil	Concrete	Concrete floor finishes and concrete stairway and ladder landings should be designed to prevent falls and obstructions..
826	Slab On Grade	Civil	Concrete	Concrete floor finishes and concrete stairway and ladder landings should be designed to prevent falls and obstructions..
827	Slab On Grade	Civil	Concrete	Concrete floor finishes and concrete stairway and ladder landings should be designed to prevent falls and obstructions..
828	Slab On Grade	Civil	Concrete	Concrete floor finishes and concrete stairway and ladder landings should be designed to prevent falls and obstructions..
829	Slab On Grade	Civil	Concrete	Concrete floor finishes and concrete stairway and ladder landings should be designed to prevent falls and obstructions..
830	Slab On Grade	Civil	Concrete	Concrete floor finishes and concrete stairway and ladder landings should be designed to prevent falls and obstructions..
831	Slab On Grade	Civil	Concrete	Concrete floor finishes and concrete stairway and ladder landings should be designed to prevent falls and obstructions..
832	Elevated Floor Concrete	Civil	Concrete	Concrete: Elevated Floor Concrete
833	Elevated Floor Concrete	Civil	Concrete	Concrete: Elevated Floor Concrete
834	Elevated Floor Concrete	Civil	Concrete	Concrete: Elevated Floor Concrete
835	Elevated Floor Concrete	Civil	Concrete	Concrete: Elevated Floor Concrete
836	Elevated Floor Concrete	Civil	Concrete	Concrete: Elevated Floor Concrete
837	Formwork	Civil	Concrete	Concrete: Formwork
838	Formwork	Civil	Concrete	Concrete: Formwork
839	Formwork	Civil	Concrete	Concrete: Formwork

840	Formwork	Civil	Concrete	Concrete: Formwork
841	Formwork	Civil	Concrete	Concrete: Formwork
842	Formwork	Civil	Concrete	Concrete: Formwork
843	Formwork	Civil	Concrete	Concrete: Formwork
844	Formwork	Civil	Concrete	Concrete: Formwork
845	Formwork	Civil	Concrete	Concrete: Formwork
846	Formwork	Civil	Concrete	Concrete: Formwork
847	Concrete Masonry Units (Concrete Blocks)	Civil	Concrete	Construction workers can sustain injuries due to repeated lifting of masonry blocks which are heavy, odd-sized, or irregularly shaped. Crowded and confined areas below elevated masonry work increases the risk of workers being struck by falling bricks, ma
848	Concrete Masonry Units (Concrete Blocks)	Civil	Concrete	Construction workers can sustain injuries due to repeated lifting of masonry blocks which are heavy, odd-sized, or irregularly shaped. Crowded and confined areas below elevated masonry work increases the risk of workers being struck by falling bricks, ma
849	Concrete Masonry Units (Concrete Blocks)	Civil	Concrete	Construction workers can sustain injuries due to repeated lifting of masonry blocks which are heavy, odd-sized, or irregularly shaped. Crowded and confined areas below elevated masonry work increases the risk of workers being struck by falling bricks, ma
850	Concrete Masonry Units (Concrete Blocks)	Civil	Concrete	Construction workers can sustain injuries due to repeated lifting of masonry blocks which are heavy, odd-sized, or irregularly shaped. Crowded and confined areas below elevated masonry work increases the risk of workers being struck by falling bricks, ma
851	Concrete Masonry Units (Concrete Blocks)	Civil	Concrete	Construction workers can sustain injuries due to repeated lifting of masonry blocks which are heavy, odd-sized, or irregularly shaped. Crowded and confined areas below elevated masonry work increases the risk of workers being struck by falling bricks, ma
852	Concrete Masonry Units (Concrete Blocks)	Civil	Concrete	Construction workers can sustain injuries due to repeated lifting of masonry blocks which are heavy, odd-sized, or irregularly shaped. Crowded and confined areas below elevated masonry work increases the risk of workers being struck by falling bricks, ma

853	Reinforcing	Civil	Concrete	The manipulation and erection of reinforcing steel and formwork for reinforced concrete structural members can be hazardous to construction workers.
854	Reinforcing	Civil	Concrete	The manipulation and erection of reinforcing steel and formwork for reinforced concrete structural members can be hazardous to construction workers.
855	Reinforcing	Civil	Concrete	The manipulation and erection of reinforcing steel and formwork for reinforced concrete structural members can be hazardous to construction workers.
856	Reinforcing	Civil	Concrete	The manipulation and erection of reinforcing steel and formwork for reinforced concrete structural members can be hazardous to construction workers.
857	Reinforcing	Civil	Concrete	The manipulation and erection of reinforcing steel and formwork for reinforced concrete structural members can be hazardous to construction workers.
858	Reinforcing	Civil	Concrete	The manipulation and erection of reinforcing steel and formwork for reinforced concrete structural members can be hazardous to construction workers.
859	Reinforcing	Civil	Concrete	The manipulation and erection of reinforcing steel and formwork for reinforced concrete structural members can be hazardous to construction workers.
860	Reinforcing	Civil	Concrete	The manipulation and erection of reinforcing steel and formwork for reinforced concrete structural members can be hazardous to construction workers.
861	Reinforcing	Civil	Concrete	The manipulation and erection of reinforcing steel and formwork for reinforced concrete structural members can be hazardous to construction workers.
862	Specifications	Civil	Concrete	Concrete: Specifications
863	Signs, Barricades	Civil	Barricades, Signs, And Warning Devices	The design and erection sequence of permanent signs can create obstruction and other safety hazards for construction workers.
864	Signs, Barricades	Civil	Barricades, Signs, And Warning Devices	The design and erection sequence of permanent signs can create obstruction and other safety hazards for construction workers.
865	Signs, Barricades	Civil	Barricades, Signs, And Warning Devices	The design and erection sequence of permanent signs can create obstruction and other safety hazards for construction workers.
866	Signs, Barricades	Civil	Barricades, Signs, And Warning Devices	The design and erection sequence of permanent signs can create obstruction and other safety hazards for construction workers.
867	Warning Devices	Electrical	Barricades, Signs, And Warning Devices	Inadequate safety warning devices and signs can lead to safety hazards for construction workers.
868	Warning Devices	Electrical	Barricades, Signs, And Warning Devices	Inadequate safety warning devices and signs can lead to safety hazards for construction workers.

869	Warning Devices	Electrical; I&C	Barricades, Signs, And Warning Devices	Inadequate safety warning devices and signs can lead to safety hazards for construction workers.
870	Warning Devices	Electrical	Barricades, Signs, And Warning Devices	Inadequate safety warning devices and signs can lead to safety hazards for construction workers.
871	Warning Devices	Electrical	Barricades, Signs, And Warning Devices	Inadequate safety warning devices and signs can lead to safety hazards for construction workers.
872	Warning Devices	Civil	Barricades, Signs, And Warning Devices	Inadequate safety warning devices and signs can lead to safety hazards for construction workers.
873	sound	Civil	Environmental Health	sound specifications
874	sound	Civil	Environmental Health	sound specifications
875	sound	Civil	Environmental Health	sound specifications
876	worker issues	Civil	Fiberglass	worker specifications
877	worker issues	Civil	Fiberglass	worker specifications
878	worker issues	Civil	Fiberglass	worker specifications
879	worker issues	Civil	Fiberglass	worker specifications
880	worker issues	Civil	Fiberglass	worker specifications
881	fiberglass ground assembly	Civil	Fiberglass	
882	general	Civil	Fiberglass	
883	general	Civil	Fiberglass	
884	Ammonia	I&C	Ammonia	Design Requirements
885	Ammonia	I&C	Ammonia	Design Requirements
886	Ammonia	I&C	Ammonia	Design Requirements
887	Improve safety through use of primary and secondary isolation valves	Mechanical		If an item has an equipment tag it must be isolated and under a Plant Clearence before servicing or any maintenance can be performed. AOV's can not be used as a Clearence isolation valve, they are maintenance items. They are passive process control equipment items. MOV's can be used as isolation valves, but can not be serviced or worked on if they are tagged-out.

888	Horizontally Supported Tanks	Civil	Ammonia Storage Tank	Horizontally mounted ammonia tanks (20,500 gal capacity) should have a pinned saddle support and sliding saddle support. Failure to provide this type of support will produce unevaluated internal stresses in the tank shell and foundation structure.
889	Buildings - Coating & Finishes	Mechanical	Buildings - Coating & Finishes	Buildings - Coating & Finishes
890	Buildings - Coating & Finishes	Mechanical	Buildings - Coating & Finishes	Buildings - Coating & Finishes
891	Buildings - Coating & Finishes	Mechanical	Buildings - Coating & Finishes	Buildings - Coating & Finishes
892	Buildings - Coating & Finishes	Mechanical	Buildings - Coating & Finishes	Buildings - Coating & Finishes
893	Buildings - Coordination	Civil	Buildings - Coordination	Buildings - Coordination
894	Buildings - Coordination	Civil	Buildings - Coordination	Buildings - Coordination
895	Buildings - Design Considerations	Civil	Buildings - Design Considerations	Buildings - Design Considerations
896	Buildings - Design Considerations	Civil	Buildings - Design Considerations	Buildings - Design Considerations
897	Buildings - Design Considerations	Civil	Buildings - Design Considerations	Buildings - Design Considerations
898	Buildings - Design Considerations	Civil	Buildings - Design Considerations	Buildings - Design Considerations
899	Buildings - Design Considerations	Civil	Buildings - Design Considerations	Buildings - Design Considerations
900	Buildings - Design Considerations	Civil	Buildings - Design Considerations	Buildings - Design Considerations
901	Buildings - Design Considerations	Civil	Buildings - Design Considerations	Buildings - Design Considerations
902	Buildings - Design Considerations	Civil	Buildings - Design Considerations	Buildings - Design Considerations
903	Buildings - Design Considerations	Civil	Buildings - Design Considerations	Buildings - Design Considerations
904	Buildings - Design Considerations	Civil	Buildings - Design Considerations	Buildings - Design Considerations
905	Buildings - Design Considerations	Civil	Buildings - Design Considerations	Buildings - Design Considerations
906	Buildings - Design Considerations	Civil	Buildings - Design Considerations	Buildings - Design Considerations
907	Buildings - Design Considerations	Civil	Buildings - Design Considerations	Buildings - Design Considerations

908	Buildings - Design Considerations	Civil	Buildings - Design Considerations	Buildings - Design Considerations
909	Buildings - Design Considerations	Civil	Buildings - Design Considerations	Buildings - Design Considerations
910	Buildings - Scheduling	Admin	Buildings - Scheduling	Buildings - Scheduling
911	Buildings - Scheduling	Admin	Buildings - Scheduling	Buildings - Scheduling
912	Buildings - Scheduling	Admin	Buildings - Scheduling	Buildings - Scheduling
913	Buildings - Scheduling	Admin	Buildings - Scheduling	Buildings - Scheduling
914	Buildings - Scheduling	Admin	Buildings - Scheduling	Buildings - Scheduling
915	Buildings - Scheduling	Admin	Buildings - Scheduling	Buildings - Scheduling
916	Buildings - Scheduling	Admin	Buildings - Scheduling	Buildings - Scheduling
917	Buildings - Scheduling	Admin	Buildings - Scheduling	Buildings - Scheduling
918	Buildings - Scheduling	Admin	Buildings - Scheduling	Buildings - Scheduling
919	Buildings - Scheduling	Admin	Buildings - Scheduling	Buildings - Scheduling
920	Buildings - Scheduling	Admin	Buildings - Scheduling	Buildings - Scheduling
921	Buildings - Scheduling	Admin	Buildings - Scheduling	Buildings - Scheduling
922	Buildings - Scheduling	Admin	Buildings - Scheduling	Buildings - Scheduling
923	Buildings - Scheduling	Admin	Buildings - Scheduling	Buildings - Scheduling
924	Buildings - Scheduling	Admin	Buildings - Scheduling	Buildings - Scheduling
925	Buildings - Scheduling	Admin	Buildings - Scheduling	Buildings - Scheduling
926	Buildings - Wall Openings	Civil	Buildings - Wall Openings	Buildings - Wall Openings
927	Buildings - Wall Openings	Civil	Buildings - Wall Openings	Buildings - Wall Openings
928	Buildings - Wall Openings	Civil	Buildings - Wall Openings	Buildings - Wall Openings
929	Buildings - Wall Openings	Civil	Buildings - Wall Openings	Buildings - Wall Openings

930	Civil - Excavation & Backfill	Civil	Civil - Excavation & Backfill	Civil - Excavation & Backfill
931	Civil - Excavation & Backfill	Civil	Civil - Excavation & Backfill	Civil - Excavation & Backfill
932	Civil - Excavation & Backfill	Civil	Civil - Excavation & Backfill	Civil - Excavation & Backfill
933	Civil - Excavation & Backfill	Civil	Civil - Excavation & Backfill	Civil - Excavation & Backfill
934	Civil - Excavation & Backfill	Civil	Civil - Excavation & Backfill	Civil - Excavation & Backfill
935	Civil - Excavation & Backfill	Civil	Civil - Excavation & Backfill	Civil - Excavation & Backfill
936	Civil - Grading & Roads	Civil	Civil - Grading & Roads	Civil - Grading & Roads
937	Civil - Grading & Roads	Civil	Civil - Grading & Roads	Civil - Grading & Roads
938	Civil - Grading & Roads	Civil	Civil - Grading & Roads	Civil - Grading & Roads
939	Civil - Grading & Roads	Civil	Civil - Grading & Roads	Civil - Grading & Roads
940	Civil - Grading & Roads	Civil	Civil - Grading & Roads	Civil - Grading & Roads
941	Civil - Grading & Roads	Civil	Civil - Grading & Roads	Civil - Grading & Roads
942	Civil - Grading & Roads	Civil	Civil - Grading & Roads	Civil - Grading & Roads
943	Civil - Site Layout & Survey	Civil	Civil - Site Layout & Survey	Civil - Site Layout & Survey
944	Civil - Site Layout & Survey	Civil	Civil - Site Layout & Survey	Civil - Site Layout & Survey
945	Civil - Site Layout & Survey	Civil	Civil - Site Layout & Survey	Civil - Site Layout & Survey
946	Civil - Underground Pipe & Utilities	Civil	Civil - Underground Pipe & Utilities	Civil - Underground Pipe & Utilities
947	Civil - Underground Pipe & Utilities	Civil	Civil - Underground Pipe & Utilities	Civil - Underground Pipe & Utilities
948	Civil - Underground Pipe & Utilities	Civil	Civil - Underground Pipe & Utilities	Civil - Underground Pipe & Utilities
949	Civil - Underground Pipe & Utilities	Civil	Civil - Underground Pipe & Utilities	Civil - Underground Pipe & Utilities
950	Civil - Underground Pipe & Utilities	Civil	Civil - Underground Pipe & Utilities	Civil - Underground Pipe & Utilities
951	Civil - Underground Pipe & Utilities	Civil	Civil - Underground Pipe & Utilities	Civil - Underground Pipe & Utilities
952	Civil - Underground Pipe & Utilities	Civil	Civil - Underground Pipe & Utilities	Civil - Underground Pipe & Utilities
953	Civil - Underground Pipe & Utilities	Civil	Civil - Underground Pipe & Utilities	Civil - Underground Pipe & Utilities

954	Concrete - Anchor Bolts & Embeds	Civil	Concrete - Anchor Bolts & Embeds	Concrete - Anchor Bolts & Embeds
955	Concrete - Anchor Bolts & Embeds	Civil	Concrete - Anchor Bolts & Embeds	Concrete - Anchor Bolts & Embeds
956	Concrete - Anchor Bolts & Embeds	Civil	Concrete - Anchor Bolts & Embeds	Concrete - Anchor Bolts & Embeds
957	Concrete - Anchor Bolts & Embeds	Civil	Concrete - Anchor Bolts & Embeds	Concrete - Anchor Bolts & Embeds
958	Concrete - Anchor Bolts & Embeds	Civil	Concrete - Anchor Bolts & Embeds	Concrete - Anchor Bolts & Embeds
959	Concrete - Anchor Bolts & Embeds	Civil	Concrete - Anchor Bolts & Embeds	Concrete - Anchor Bolts & Embeds
960	Concrete - Anchor Bolts & Embeds	Civil	Concrete - Anchor Bolts & Embeds	Concrete - Anchor Bolts & Embeds
961	Concrete - Concrete Mixing	Civil	Concrete - Concrete Mixing	Concrete - Concrete Mixing
962	Concrete - Concrete Mixing	Civil	Concrete - Concrete Mixing	Concrete - Concrete Mixing
963	Concrete - Foundations	Civil	Concrete - Foundations	Concrete - Foundations
964	Concrete - Foundations	Civil	Concrete - Foundations	Concrete - Foundations
965	Concrete - Foundations	Civil	Concrete - Foundations	Concrete - Foundations
966	Concrete - Foundations	Civil	Concrete - Foundations	Concrete - Foundations
967	Concrete - Foundations	Civil	Concrete - Foundations	Concrete - Foundations
968	Concrete - Foundations	Civil	Concrete - Foundations	Concrete - Foundations
969	Concrete - Foundations	Civil	Concrete - Foundations	Concrete - Foundations
970	Concrete - Foundations	Civil	Concrete - Foundations	Concrete - Foundations
971	Concrete - Foundations	Civil	Concrete - Foundations	Concrete - Foundations
972	Concrete - Foundations	Civil	Concrete - Foundations	Concrete - Foundations
973	Concrete - Foundations	Civil	Concrete - Foundations	Concrete - Foundations
974	Concrete - Foundations	Civil	Concrete - Foundations	Concrete - Foundations
975	Concrete - Foundations	Civil	Concrete - Foundations	Concrete - Foundations

976	Concrete - Foundations	Civil	Concrete - Foundations	Concrete - Foundations
977	Concrete - Foundations	Civil	Concrete - Foundations	Concrete - Foundations
978	Concrete - Piles & Piers	Civil	Concrete - Piles & Piers	Concrete - Piles & Piers
979	Concrete - Precast Concrete	Civil	Concrete - Precast Concrete	Concrete - Precast Concrete
980	Concrete - Precast Concrete	Civil	Concrete - Precast Concrete	Concrete - Precast Concrete
981	Concrete - Rebar	Civil	Concrete - Rebar	Concrete - Rebar
982	Concrete - Rebar	Civil	Concrete - Rebar	Concrete - Rebar
983	Concrete - Rebar	Civil	Concrete - Rebar	Concrete - Rebar
984	Concrete - Roads & Paving	Civil	Concrete - Roads & Paving	Concrete - Roads & Paving
985	Concrete - Roads & Paving	Civil	Concrete - Roads & Paving	Concrete - Roads & Paving
986	Concrete - Roads & Paving	Civil	Concrete - Roads & Paving	Concrete - Roads & Paving
987	Construction - Concrete	Civil	Construction - Concrete	Construction - Concrete
988	Construction - Concrete	Civil	Construction - Concrete	Construction - Concrete
989	Construction - Concrete	Civil	Construction - Concrete	Construction - Concrete
990	Construction - Concrete	Civil	Construction - Concrete	Construction - Concrete
991	Construction - Concrete	Civil	Construction - Concrete	Construction - Concrete
992	Construction - Electrical	Electrical	Construction - Electrical	Construction - Electrical
993	Construction - Electrical	Electrical	Construction - Electrical	Construction - Electrical
994	Construction - Electrical	Electrical	Construction - Electrical	Construction - Electrical
995	Construction - Electrical	Electrical	Construction - Electrical	Construction - Electrical
996	Construction - Electrical	Electrical	Construction - Electrical	Construction - Electrical
997	Construction - Equipment	Other	Construction - Equipment	Construction - Equipment
998	Construction - Equipment	Other	Construction - Equipment	Construction - Equipment

999	Construction - Equipment	Other	Construction - Equipment	Construction - Equipment
1000	Construction - Equipment	Other	Construction - Equipment	Construction - Equipment
1001	Construction - Equipment	Other	Construction - Equipment	Construction - Equipment
1002	Construction - Equipment	Other	Construction - Equipment	Construction - Equipment
1003	Construction - Equipment	Other	Construction - Equipment	Construction - Equipment
1004	Construction - Equipment	Other	Construction - Equipment	Construction - Equipment
1005	Construction - Equipment	Other	Construction - Equipment	Construction - Equipment
1006	Construction - Material	Other	Construction - Material	Construction - Material
1007	Construction - Piping	Mechanical	Construction - Piping	Construction - Piping
1008	Construction - Piping	Mechanical	Construction - Piping	Construction - Piping
1009	Construction - Piping	Mechanical	Construction - Piping	Construction - Piping
1010	Construction - Piping	Mechanical	Construction - Piping	Construction - Piping
1011	Construction - Piping	Mechanical	Construction - Piping	Construction - Piping
1012	Construction - Safety	Other	Construction - Safety	Construction - Safety
1013	Construction - Safety	Other	Construction - Safety	Construction - Safety
1014	Construction - Safety	Other	Construction - Safety	Construction - Safety
1015	Construction - Safety	Other	Construction - Safety	Construction - Safety
1016	Construction - Safety	Other	Construction - Safety	Construction - Safety
1017	Construction - Safety	Other	Construction - Safety	Construction - Safety
1018	Construction - Staff Responsibility	Other	Construction - Staff Responsibility	Construction - Staff Responsibility
1019	Construction - Staff Responsibility	Other	Construction - Staff Responsibility	Construction - Staff Responsibility

1020	Construction - Staff Responsibility	Other	Construction - Staff Responsibility	Construction - Staff Responsibility
1021	Construction - Staff Responsibility	Other	Construction - Staff Responsibility	Construction - Staff Responsibility
1022	Construction - Staff Responsibility	Other	Construction - Staff Responsibility	Construction - Staff Responsibility
1023	Construction - Staff Responsibility	Other	Construction - Staff Responsibility	Construction - Staff Responsibility
1024	Construction - Staff Responsibility	Other	Construction - Staff Responsibility	Construction - Staff Responsibility
1025	Construction - Staff Responsibility	Other	Construction - Staff Responsibility	Construction - Staff Responsibility
1026	Construction - Staff Responsibility	Other	Construction - Staff Responsibility	Construction - Staff Responsibility
1027	Construction - Staff Responsibility	Other	Construction - Staff Responsibility	Construction - Staff Responsibility
1028	Construction - Staff Responsibility	Other	Construction - Staff Responsibility	Construction - Staff Responsibility
1029	Construction - Staff Responsibility	Other	Construction - Staff Responsibility	Construction - Staff Responsibility
1030	Construction - Staff Responsibility	Other	Construction - Staff Responsibility	Construction - Staff Responsibility
1031	Construction - Staff Responsibility	Other	Construction - Staff Responsibility	Construction - Staff Responsibility
1032	Construction - Staff Responsibility	Other	Construction - Staff Responsibility	Construction - Staff Responsibility
1033	Construction - Staff Responsibility	Other	Construction - Staff Responsibility	Construction - Staff Responsibility
1034	Construction - Staff Responsibility	Other	Construction - Staff Responsibility	Construction - Staff Responsibility
1035	Construction - Staff Responsibility	Other	Construction - Staff Responsibility	Construction - Staff Responsibility
1036	Construction - Temporary Facilities	Other	Construction - Temporary Facilities	Construction - Temporary Facilities
1037	Construction - Temporary Facilities	Other	Construction - Temporary Facilities	Construction - Temporary Facilities
1038	Construction - Temporary Facilities	Other	Construction - Temporary Facilities	Construction - Temporary Facilities
1039	Construction - Temporary Facilities	Other	Construction - Temporary Facilities	Construction - Temporary Facilities

1040	Construction - Temporary Facilities	Other	Construction - Temporary Facilities	Construction - Temporary Facilities
1041	Construction - Temporary Facilities	Other	Construction - Temporary Facilities	Construction - Temporary Facilities
1042	Construction - Temporary Facilities	Other	Construction - Temporary Facilities	Construction - Temporary Facilities
1043	Construction - Temporary Facilities	Other	Construction - Temporary Facilities	Construction - Temporary Facilities
1044	Construction - Temporary Facilities	Other	Construction - Temporary Facilities	Construction - Temporary Facilities
1045	Construction - Temporary Facilities	Other	Construction - Temporary Facilities	Construction - Temporary Facilities
1046	Construction - Temporary Facilities	Other	Construction - Temporary Facilities	Construction - Temporary Facilities
1047	Construction - Temporary Facilities	Other	Construction - Temporary Facilities	Construction - Temporary Facilities
1048	Construction - Temporary Facilities	Other	Construction - Temporary Facilities	Construction - Temporary Facilities
1049	Construction - Temporary Facilities	Other	Construction - Temporary Facilities	Construction - Temporary Facilities
1050	Construction - Temporary Facilities	Other	Construction - Temporary Facilities	Construction - Temporary Facilities
1051	Construction - Temporary Facilities	Other	Construction - Temporary Facilities	Construction - Temporary Facilities
1052	Construction - Temporary Facilities	Other	Construction - Temporary Facilities	Construction - Temporary Facilities
1053	Construction - Temporary Facilities	Other	Construction - Temporary Facilities	Construction - Temporary Facilities
1054	Construction - Temporary Facilities	Other	Construction - Temporary Facilities	Construction - Temporary Facilities
1055	Construction - Temporary Facilities	Other	Construction - Temporary Facilities	Construction - Temporary Facilities
1056	Construction - Temporary Facilities	Other	Construction - Temporary Facilities	Construction - Temporary Facilities
1057	Construction - Temporary Facilities	Other	Construction - Temporary Facilities	Construction - Temporary Facilities
1058	Construction - Temporary Facilities	Other	Construction - Temporary Facilities	Construction - Temporary Facilities
1059	Construction - Temporary Facilities	Other	Construction - Temporary Facilities	Construction - Temporary Facilities
1060	Construction - Temporary Facilities	Other	Construction - Temporary Facilities	Construction - Temporary Facilities

1061	Construction - Temporary Facilities	Other	Construction - Temporary Facilities	Construction - Temporary Facilities
1062	Construction - Temporary Facilities	Other	Construction - Temporary Facilities	Construction - Temporary Facilities
1063	Construction - Temporary Facilities	Other	Construction - Temporary Facilities	Construction - Temporary Facilities
1064	Construction - Temporary Facilities	Other	Construction - Temporary Facilities	Construction - Temporary Facilities
1065	Construction - Temporary Facilities	Other	Construction - Temporary Facilities	Construction - Temporary Facilities
1066	Construction - Temporary Facilities	Other	Construction - Temporary Facilities	Construction - Temporary Facilities
1067	Construction - Temporary Facilities	Other	Construction - Temporary Facilities	Construction - Temporary Facilities
1068	Construction - Temporary Facilities	Other	Construction - Temporary Facilities	Construction - Temporary Facilities
1069	Construction - Temporary Facilities	Other	Construction - Temporary Facilities	Construction - Temporary Facilities
1070	Construction - Temporary Facilities	Other	Construction - Temporary Facilities	Construction - Temporary Facilities
1071	Construction - Temporary Facilities	Other	Construction - Temporary Facilities	Construction - Temporary Facilities
1072	Construction - Temporary Facilities	Other	Construction - Temporary Facilities	Construction - Temporary Facilities
1073	Construction - Temporary Facilities	Other	Construction - Temporary Facilities	Construction - Temporary Facilities
1074	Construction - Temporary Facilities	Other	Construction - Temporary Facilities	Construction - Temporary Facilities
1075	Construction - Temporary Facilities	Other	Construction - Temporary Facilities	Construction - Temporary Facilities
1076	Construction - Temporary Facilities	Other	Construction - Temporary Facilities	Construction - Temporary Facilities
1077	Construction - Temporary Facilities	Other	Construction - Temporary Facilities	Construction - Temporary Facilities
1078	Construction - Temporary Facilities	Other	Construction - Temporary Facilities	Construction - Temporary Facilities
1079	Construction - Temporary Facilities	Other	Construction - Temporary Facilities	Construction - Temporary Facilities

1080	Construction - Temporary Facilities	Other	Construction - Temporary Facilities	Construction - Temporary Facilities
1081	Construction - Temporary Facilities	Other	Construction - Temporary Facilities	Construction - Temporary Facilities
1082	Construction - Temporary Facilities	Other	Construction - Temporary Facilities	Construction - Temporary Facilities
1083	Construction - Temporary Facilities	Other	Construction - Temporary Facilities	Construction - Temporary Facilities
1084	Construction - Testing	Other	Construction - Testing	Construction - Testing
1085	Construction - Testing	Other	Construction - Testing	Construction - Testing
1086	Construction - Testing	Other	Construction - Testing	Construction - Testing
1087	Construction - Testing	Other	Construction - Testing	Construction - Testing
1088	Construction - Testing	Other	Construction - Testing	Construction - Testing
1089	Construction - Testing	Other	Construction - Testing	Construction - Testing
1090	Construction - Testing	Other	Construction - Testing	Construction - Testing
1091	Construction - Testing	Other	Construction - Testing	Construction - Testing
1092	Construction - Testing	Other	Construction - Testing	Construction - Testing
1093	Construction - Testing	Other	Construction - Testing	Construction - Testing
1094	Construction - Testing	Other	Construction - Testing	Construction - Testing
1095	Construction - Testing	Other	Construction - Testing	Construction - Testing
1096	Construction - Tools	Other	Construction - Tools	Construction - Tools
1097	Construction - Tools	Other	Construction - Tools	Construction - Tools
1098	Construction - Tools	Other	Construction - Tools	Construction - Tools
1099	Construction - Tools	Other	Construction - Tools	Construction - Tools
1100	Construction - Tools	Other	Construction - Tools	Construction - Tools
1101	Construction - Tools	Other	Construction - Tools	Construction - Tools
1102	Construction - Tools	Other	Construction - Tools	Construction - Tools
1103	Construction - Tools	Other	Construction - Tools	Construction - Tools

1104	Construction - Tools	Other	Construction - Tools	Construction - Tools
1105	Construction - Tools	Other	Construction - Tools	Construction - Tools
1106	Construction - Tools	Other	Construction - Tools	Construction - Tools
1107	Construction - Tools	Other	Construction - Tools	Construction - Tools
1108	Construction - Turnover	Other	Construction - Turnover	Construction - Turnover
1109	Construction - Turnover	Other	Construction - Turnover	Construction - Turnover
1110	Construction - Turnover	Other	Construction - Turnover	Construction - Turnover
1111	Construction - Turnover	Other	Construction - Turnover	Construction - Turnover
1112	Construction - Turnover	Other	Construction - Turnover	Construction - Turnover
1113	Construction - Turnover	Other	Construction - Turnover	Construction - Turnover
1114	Construction - Turnover	Other	Construction - Turnover	Construction - Turnover
1115	Construction - Turnover	Other	Construction - Turnover	Construction - Turnover
1116	Control Systems - Cable	I&C	Control Systems - Cable	Control Systems - Cable
1117	Control Systems - Cable	I&C	Control Systems - Cable	Control Systems - Cable
1118	Control Systems - Cable	I&C	Control Systems - Cable	Control Systems - Cable
1119	Control Systems - Conduit	Electrical	Control Systems - Conduit	Control Systems - Conduit
1120	Control Systems - Conduit	Electrical	Control Systems - Conduit	Control Systems - Conduit
1121	Control Systems - Conduit	Electrical	Control Systems - Conduit	Control Systems - Conduit
1122	Control Systems - Conduit	Electrical	Control Systems - Conduit	Control Systems - Conduit
1123	Control Systems - Conduit	Electrical	Control Systems - Conduit	Control Systems - Conduit
1124	Control Systems - Conduit	Electrical	Control Systems - Conduit	Control Systems - Conduit
1125	Control Systems - Control Building	I&C	Control Systems - Control Building	Control Systems - Control Building
1126	Control Systems - Control Building	I&C	Control Systems - Control Building	Control Systems - Control Building
1127	Control Systems - Design Considerations	I&C	Control Systems - Design Considerations	Control Systems - Design Considerations

1128	Control Systems - Design Considerations	I&C	Control Systems - Design Considerations	Control Systems - Design Considerations
1129	Control Systems - Design Considerations	I&C	Control Systems - Design Considerations	Control Systems - Design Considerations
1130	Control Systems - Design Considerations	I&C	Control Systems - Design Considerations	Control Systems - Design Considerations
1131	Control Systems - Design Considerations	I&C	Control Systems - Design Considerations	Control Systems - Design Considerations
1132	Control Systems - Design Considerations	I&C	Control Systems - Design Considerations	Control Systems - Design Considerations
1133	Control Systems - Design Considerations	I&C	Control Systems - Design Considerations	Control Systems - Design Considerations
1134	Control Systems - Design Considerations	I&C	Control Systems - Design Considerations	Control Systems - Design Considerations
1135	Control Systems - Design Considerations	I&C	Control Systems - Design Considerations	Control Systems - Design Considerations
1136	Control Systems - Design Considerations	I&C	Control Systems - Design Considerations	Control Systems - Design Considerations
1137	Control Systems - Design Considerations	I&C	Control Systems - Design Considerations	Control Systems - Design Considerations
1138	Control Systems - Instruments	I&C	Control Systems - Instruments	Control Systems - Instruments
1139	Control Systems - Instruments	I&C	Control Systems - Instruments	Control Systems - Instruments
1140	Control Systems - Instruments	I&C	Control Systems - Instruments	Control Systems - Instruments
1141	Control Systems - Instruments	I&C	Control Systems - Instruments	Control Systems - Instruments
1142	Control Systems - Instruments	I&C	Control Systems - Instruments	Control Systems - Instruments
1143	Control Systems - Instruments	I&C	Control Systems - Instruments	Control Systems - Instruments
1144	Control Systems - Instruments	I&C	Control Systems - Instruments	Control Systems - Instruments
1145	Control Systems - Junction Boxes	I&C	Control Systems - Junction Boxes	Control Systems - Junction Boxes
1146	Control Systems - Junction Boxes	I&C	Control Systems - Junction Boxes	Control Systems - Junction Boxes
1147	Control Systems - Loop Drawings	I&C	Control Systems - Loop Drawings	Control Systems - Loop Drawings
1148	Control Systems - Loop Drawings	I&C	Control Systems - Loop Drawings	Control Systems - Loop Drawings

1149	Control Systems - Testing	I&C	Control Systems - Testing	Control Systems - Testing
1150	Control Systems - Testing	I&C	Control Systems - Testing	Control Systems - Testing
1151	Control Systems - Testing	I&C	Control Systems - Testing	Control Systems - Testing
1152	Control Systems - Tubing	I&C	Control Systems - Tubing	Control Systems - Tubing
1153	Control Systems - Tubing	I&C	Control Systems - Tubing	Control Systems - Tubing
1154	Control Systems - Tubing	I&C	Control Systems - Tubing	Control Systems - Tubing
1155	Control Systems - Tubing	I&C	Control Systems - Tubing	Control Systems - Tubing
1156	Control Systems - Vendor Requirements	I&C	Control Systems - Vendor Requirements	Control Systems - Vendor Requirements
1157	Control Systems - Vendor Requirements	I&C	Control Systems - Vendor Requirements	Control Systems - Vendor Requirements
1158	Control Systems - Vendor Requirements	I&C	Control Systems - Vendor Requirements	Control Systems - Vendor Requirements
1159	Control Systems - Vendor Requirements	I&C	Control Systems - Vendor Requirements	Control Systems - Vendor Requirements
1160	Control Systems - Vendor Requirements	I&C	Control Systems - Vendor Requirements	Control Systems - Vendor Requirements
1161	Control Systems - Vendor Requirements	I&C	Control Systems - Vendor Requirements	Control Systems - Vendor Requirements
1162	Electrical - Automation	Electrical	Electrical - Automation	Electrical - Automation
1163	Electrical - Automation	Electrical	Electrical - Automation	Electrical - Automation
1164	Electrical - Cable Power	Electrical	Electrical - Cable Power	Electrical - Cable Power
1165	Electrical - Cable Power	Electrical	Electrical - Cable Power	Electrical - Cable Power
1166	Electrical - Cable Power	Electrical	Electrical - Cable Power	Electrical - Cable Power
1167	Electrical - Cable Power	Electrical	Electrical - Cable Power	Electrical - Cable Power
1168	Electrical - Cable Power	Electrical	Electrical - Cable Power	Electrical - Cable Power
1169	Electrical - Cable Power	Electrical	Electrical - Cable Power	Electrical - Cable Power

1170	Electrical - Cable Tray	Electrical	Electrical - Cable Tray	Electrical - Cable Tray
1171	Electrical - Cable Tray	Electrical	Electrical - Cable Tray	Electrical - Cable Tray
1172	Electrical - Cable Tray	Electrical	Electrical - Cable Tray	Electrical - Cable Tray
1173	Electrical - Conduit	Electrical	Electrical - Conduit	Electrical - Conduit
1174	Electrical - Conduit	Electrical	Electrical - Conduit	Electrical - Conduit
1175	Electrical - Conduit	Electrical	Electrical - Conduit	Electrical - Conduit
1176	Electrical - Conduit	Electrical	Electrical - Conduit	Electrical - Conduit
1177	Electrical - Conduit	Electrical	Electrical - Conduit	Electrical - Conduit
1178	Electrical - Conduit	Electrical	Electrical - Conduit	Electrical - Conduit
1179	Electrical - Conduit	Electrical	Electrical - Conduit	Electrical - Conduit
1180	Electrical - Conduit	Electrical	Electrical - Conduit	Electrical - Conduit
1181	Electrical - Conduit	Electrical	Electrical - Conduit	Electrical - Conduit
1182	Electrical - Conduit	Electrical	Electrical - Conduit	Electrical - Conduit
1183	Electrical - Conduit	Electrical	Electrical - Conduit	Electrical - Conduit
1184	Electrical - Conduit	Electrical	Electrical - Conduit	Electrical - Conduit
1185	Electrical - Design Considerations	Electrical	Electrical - Design Considerations	Electrical - Design Considerations
1186	Electrical - Design Considerations	Electrical	Electrical - Design Considerations	Electrical - Design Considerations
1187	Electrical - Design Considerations	Electrical	Electrical - Design Considerations	Electrical - Design Considerations
1188	Electrical - Design Considerations	Electrical	Electrical - Design Considerations	Electrical - Design Considerations
1189	Electrical - Design Considerations	Electrical	Electrical - Design Considerations	Electrical - Design Considerations
1190	Electrical - Design Considerations	Electrical	Electrical - Design Considerations	Electrical - Design Considerations
1191	Electrical - Design Considerations	Electrical	Electrical - Design Considerations	Electrical - Design Considerations

1192	Electrical - Design Considerations	Electrical	Electrical - Design Considerations	Electrical - Design Considerations
1193	Electrical - Design Considerations	Electrical	Electrical - Design Considerations	Electrical - Design Considerations
1194	Electrical - Design Considerations	Electrical	Electrical - Design Considerations	Electrical - Design Considerations
1195	Electrical - Design Considerations	Electrical	Electrical - Design Considerations	Electrical - Design Considerations
1196	Electrical - Design Considerations	Electrical	Electrical - Design Considerations	Electrical - Design Considerations
1197	Electrical - Design Considerations	Electrical	Electrical - Design Considerations	Electrical - Design Considerations
1198	Electrical - Design Considerations	Electrical	Electrical - Design Considerations	Electrical - Design Considerations
1199	Electrical - Design Considerations	Electrical	Electrical - Design Considerations	Electrical - Design Considerations
1200	Electrical - Design Considerations	Electrical	Electrical - Design Considerations	Electrical - Design Considerations
1201	Electrical - Design Considerations	Electrical	Electrical - Design Considerations	Electrical - Design Considerations
1202	Electrical - Design Considerations	Electrical	Electrical - Design Considerations	Electrical - Design Considerations
1203	Electrical - Design Considerations	Electrical	Electrical - Design Considerations	Electrical - Design Considerations
1204	Electrical - Grounding	Electrical	Electrical - Grounding	Electrical - Grounding
1205	Electrical - Grounding	Electrical	Electrical - Grounding	Electrical - Grounding
1206	Electrical - Grounding	Electrical	Electrical - Grounding	Electrical - Grounding
1207	Electrical - Grounding	Electrical	Electrical - Grounding	Electrical - Grounding
1208	Electrical - Grounding	Electrical	Electrical - Grounding	Electrical - Grounding
1209	Electrical - Grounding	Electrical	Electrical - Grounding	Electrical - Grounding
1210	Electrical - Grounding	Electrical	Electrical - Grounding	Electrical - Grounding
1211	Electrical - Lighting	Electrical	Electrical - Lighting	Electrical - Lighting
1212	Electrical - Lighting	Electrical	Electrical - Lighting	Electrical - Lighting
1213	Electrical - Lighting	Electrical	Electrical - Lighting	Electrical - Lighting
1214	Electrical - Material	Electrical	Electrical - Material	Electrical - Material

1215	Electrical - Material	Electrical	Electrical - Material	Electrical - Material
1216	Electrical - Material	Electrical	Electrical - Material	Electrical - Material
1217	Electrical - Material	Electrical	Electrical - Material	Electrical - Material
1218	Electrical - Material	Electrical	Electrical - Material	Electrical - Material
1219	Electrical - Power	Electrical	Electrical - Power	Electrical - Power
1220	Electrical - Power	Electrical	Electrical - Power	Electrical - Power
1221	Electrical - Power	Electrical	Electrical - Power	Electrical - Power
1222	Electrical - Power	Electrical	Electrical - Power	Electrical - Power
1223	Electrical - Power	Electrical	Electrical - Power	Electrical - Power
1224	Electrical - Power	Electrical	Electrical - Power	Electrical - Power
1225	Electrical - Power	Electrical	Electrical - Power	Electrical - Power
1226	Electrical - Power	Electrical	Electrical - Power	Electrical - Power
1227	Electrical - Power	Electrical	Electrical - Power	Electrical - Power
1228	Electrical - Power	Electrical	Electrical - Power	Electrical - Power
1229	Electrical - Power	Electrical	Electrical - Power	Electrical - Power
1230	Electrical - Power	Electrical	Electrical - Power	Electrical - Power
1231	Electrical - Power	Electrical	Electrical - Power	Electrical - Power
1232	Electrical - Power	Electrical	Electrical - Power	Electrical - Power
1233	Electrical - Power	Electrical	Electrical - Power	Electrical - Power
1234	Electrical - Power	Electrical	Electrical - Power	Electrical - Power
1235	Electrical - Power	Electrical	Electrical - Power	Electrical - Power
1236	Electrical - Power	Electrical	Electrical - Power	Electrical - Power
1237	Electrical - Power	Electrical	Electrical - Power	Electrical - Power
1238	Electrical - Power	Electrical	Electrical - Power	Electrical - Power

1239	Electrical - Power	Electrical	Electrical - Power	Electrical - Power
1240	Electrical - Power	Electrical	Electrical - Power	Electrical - Power
1241	Electrical - Power	Electrical	Electrical - Power	Electrical - Power
1242	Electrical - Power	Electrical	Electrical - Power	Electrical - Power
1243	Electrical - Power	Electrical	Electrical - Power	Electrical - Power
1244	Electrical - Substation	Electrical	Electrical - Substation	Electrical - Substation
1245	Electrical - Substation	Electrical	Electrical - Substation	Electrical - Substation
1246	Electrical - Substation	Electrical	Electrical - Substation	Electrical - Substation
1247	Electrical - Temporary Power	Electrical	Electrical - Temporary Power	Electrical - Temporary Power
1248	Electrical - Temporary Power	Electrical	Electrical - Temporary Power	Electrical - Temporary Power
1249	Electrical - Temporary Power	Electrical	Electrical - Temporary Power	Electrical - Temporary Power
1250	Electrical - Temporary Power	Electrical	Electrical - Temporary Power	Electrical - Temporary Power
1251	Electrical - Temporary Power	Electrical	Electrical - Temporary Power	Electrical - Temporary Power
1252	Electrical - Testing	Electrical	Electrical - Testing	Electrical - Testing
1253	Electrical - Vendor Requirements	Electrical	Electrical - Vendor Requirements	Electrical - Vendor Requirements
1254	Electrical - Vendor Requirements	Electrical	Electrical - Vendor Requirements	Electrical - Vendor Requirements
1255	Electrical - Vendor Requirements	Electrical	Electrical - Vendor Requirements	Electrical - Vendor Requirements
1256	Electrical - Vendor Requirements	Electrical	Electrical - Vendor Requirements	Electrical - Vendor Requirements
1257	Electrical - Vendor Requirements	Electrical	Electrical - Vendor Requirements	Electrical - Vendor Requirements
1258	Electrical - Vendor Requirements	Electrical	Electrical - Vendor Requirements	Electrical - Vendor Requirements

1259	Electrical - Vendor Requirements	Electrical	Electrical - Vendor Requirements	Electrical - Vendor Requirements
1260	Electrical - Vendor Requirements	Electrical	Electrical - Vendor Requirements	Electrical - Vendor Requirements
1261	Electrical - Vendor Requirements	Electrical	Electrical - Vendor Requirements	Electrical - Vendor Requirements
1262	Mechanical Equipment - Cleaning	Mechanical	Mechanical Equipment - Cleaning	Mechanical Equipment - Cleaning
1263	Mechanical Equipment - Cleaning	Mechanical	Mechanical Equipment - Cleaning	Mechanical Equipment - Cleaning
1264	Mechanical Equipment - Drawings & Specifications	Mechanical	Mechanical Equipment - Drawings & Specifications	Mechanical Equipment - Drawings & Specifications
1265	Mechanical Equipment - Drawings & Specifications	Mechanical	Mechanical Equipment - Drawings & Specifications	Mechanical Equipment - Drawings & Specifications
1266	Mechanical Equipment - Drawings & Specifications	Mechanical	Mechanical Equipment - Drawings & Specifications	Mechanical Equipment - Drawings & Specifications
1267	Mechanical Equipment - Exchangers	Mechanical	Mechanical Equipment - Exchangers	Mechanical Equipment - Exchangers
1268	Mechanical Equipment - Exchangers	Mechanical	Mechanical Equipment - Exchangers	Mechanical Equipment - Exchangers
1269	Mechanical Equipment - Exchangers	Mechanical	Mechanical Equipment - Exchangers	Mechanical Equipment - Exchangers
1270	Mechanical Equipment - Exchangers	Mechanical	Mechanical Equipment - Exchangers	Mechanical Equipment - Exchangers
1271	Mechanical Equipment - Exchangers	Mechanical	Mechanical Equipment - Exchangers	Mechanical Equipment - Exchangers
1272	Mechanical Equipment - Exchangers	Mechanical	Mechanical Equipment - Exchangers	Mechanical Equipment - Exchangers
1273	Mechanical Equipment - Expediting	Mechanical	Mechanical Equipment - Expediting	Mechanical Equipment - Expediting
1274	Mechanical Equipment - Expediting	Mechanical	Mechanical Equipment - Expediting	Mechanical Equipment - Expediting
1275	Mechanical Equipment - Expediting	Mechanical	Mechanical Equipment - Expediting	Mechanical Equipment - Expediting
1276	Mechanical Equipment - Expediting	Mechanical	Mechanical Equipment - Expediting	Mechanical Equipment - Expediting

1277	Mechanical Equipment - Expediting	Mechanical	Mechanical Equipment - Expediting	Mechanical Equipment - Expediting
1278	Mechanical Equipment - Expediting	Mechanical	Mechanical Equipment - Expediting	Mechanical Equipment - Expediting
1279	Mechanical Equipment - Expediting	Mechanical	Mechanical Equipment - Expediting	Mechanical Equipment - Expediting
1280	Mechanical Equipment - Expediting	Mechanical	Mechanical Equipment - Expediting	Mechanical Equipment - Expediting
1281	Mechanical Equipment - Expediting	Mechanical	Mechanical Equipment - Expediting	Mechanical Equipment - Expediting
1282	Mechanical Equipment - General	Mechanical	Mechanical Equipment - General	Mechanical Equipment - General
1283	Mechanical Equipment - Instruments	Mechanical	Mechanical Equipment - Instruments	Mechanical Equipment - Instruments
1284	Mechanical Equipment - Insulation & Coatings	Mechanical	Mechanical Equipment - Insulation & Coatings	Mechanical Equipment - Insulation & Coatings
1285	Mechanical Equipment - Insulation & Coatings	Mechanical	Mechanical Equipment - Insulation & Coatings	Mechanical Equipment - Insulation & Coatings
1286	Mechanical Equipment - Insulation & Coatings	Mechanical	Mechanical Equipment - Insulation & Coatings	Mechanical Equipment - Insulation & Coatings
1287	Mechanical Equipment - Insulation & Coatings	Mechanical	Mechanical Equipment - Insulation & Coatings	Mechanical Equipment - Insulation & Coatings
1288	Mechanical Equipment - Pre-Assembly	Mechanical	Mechanical Equipment - Pre-Assembly	Mechanical Equipment - Pre-Assembly
1289	Mechanical Equipment - Procurement & Expediting	Mechanical	Mechanical Equipment - Procurement & Expediting	Mechanical Equipment - Procurement & Expediting
1290	Mechanical Equipment - Procurement & Expediting	Mechanical	Mechanical Equipment - Procurement & Expediting	Mechanical Equipment - Procurement & Expediting
1291	Mechanical Equipment - Procurement & Expediting	Mechanical	Mechanical Equipment - Procurement & Expediting	Mechanical Equipment - Procurement & Expediting
1292	Mechanical Equipment - Procurement & Expediting	Mechanical	Mechanical Equipment - Procurement & Expediting	Mechanical Equipment - Procurement & Expediting
1293	Mechanical Equipment - Procurement & Expediting	Mechanical	Mechanical Equipment - Procurement & Expediting	Mechanical Equipment - Procurement & Expediting

1294	Mechanical Equipment - Procurement & Expediting	Mechanical	Mechanical Equipment - Procurement & Expediting	Mechanical Equipment - Procurement & Expediting
1295	Mechanical Equipment - Procurement & Expediting	Mechanical	Mechanical Equipment - Procurement & Expediting	Mechanical Equipment - Procurement & Expediting
1296	Mechanical Equipment - Procurement & Expediting	Mechanical	Mechanical Equipment - Procurement & Expediting	Mechanical Equipment - Procurement & Expediting
1297	Mechanical Equipment - Procurement & Expediting	Mechanical	Mechanical Equipment - Procurement & Expediting	Mechanical Equipment - Procurement & Expediting
1298	Mechanical Equipment - Procurement & Expediting	Mechanical	Mechanical Equipment - Procurement & Expediting	Mechanical Equipment - Procurement & Expediting
1299	Mechanical Equipment - Procurement & Expediting	Mechanical	Mechanical Equipment - Procurement & Expediting	Mechanical Equipment - Procurement & Expediting
1300	Mechanical Equipment - Pumps, Compressors & Rotating Equipment	Mechanical	Mechanical Equipment - Pumps, Compressors & Rotating Equipment	Mechanical Equipment - Pumps, Compressors & Rotating Equipment
1301	Mechanical Equipment - Pumps, Compressors & Rotating Equipment	Mechanical	Mechanical Equipment - Pumps, Compressors & Rotating Equipment	Mechanical Equipment - Pumps, Compressors & Rotating Equipment
1302	Mechanical Equipment - Pumps, Compressors & Rotating Equipment	Mechanical	Mechanical Equipment - Pumps, Compressors & Rotating Equipment	Mechanical Equipment - Pumps, Compressors & Rotating Equipment
1303	Mechanical Equipment - Pumps, Compressors & Rotating Equipment	Mechanical	Mechanical Equipment - Pumps, Compressors & Rotating Equipment	Mechanical Equipment - Pumps, Compressors & Rotating Equipment
1304	Mechanical Equipment - Pumps, Compressors & Rotating Equipment	Mechanical	Mechanical Equipment - Pumps, Compressors & Rotating Equipment	Mechanical Equipment - Pumps, Compressors & Rotating Equipment
1305	Mechanical Equipment - Pumps, Compressors & Rotating Equipment	Mechanical	Mechanical Equipment - Pumps, Compressors & Rotating Equipment	Mechanical Equipment - Pumps, Compressors & Rotating Equipment
1306	Mechanical Equipment - Pumps, Compressors & Rotating Equipment	Mechanical	Mechanical Equipment - Pumps, Compressors & Rotating Equipment	Mechanical Equipment - Pumps, Compressors & Rotating Equipment

1307	Mechanical Equipment - Pumps, Compressors & Rotating Equipment	Mechanical	Mechanical Equipment - Pumps, Compressors & Rotating Equipment	Mechanical Equipment - Pumps, Compressors & Rotating Equipment
1308	Mechanical Equipment - Safety	Mechanical	Mechanical Equipment - Safety	Mechanical Equipment - Safety
1309	Mechanical Equipment - Safety	Mechanical	Mechanical Equipment - Safety	Mechanical Equipment - Safety
1310	Mechanical Equipment - Safety	Mechanical	Mechanical Equipment - Safety	Mechanical Equipment - Safety
1311	Mechanical Equipment - Safety	Mechanical	Mechanical Equipment - Safety	Mechanical Equipment - Safety
1312	Mechanical Equipment - Safety	Mechanical	Mechanical Equipment - Safety	Mechanical Equipment - Safety
1313	Mechanical Equipment - Scheduling	Mechanical	Mechanical Equipment - Scheduling	Mechanical Equipment - Scheduling
1314	Mechanical Equipment - Scheduling	Mechanical	Mechanical Equipment - Scheduling	Mechanical Equipment - Scheduling
1315	Mechanical Equipment - Scheduling	Mechanical	Mechanical Equipment - Scheduling	Mechanical Equipment - Scheduling
1316	Mechanical Equipment - Scheduling	Mechanical	Mechanical Equipment - Scheduling	Mechanical Equipment - Scheduling
1317	Mechanical Equipment - Scheduling	Mechanical	Mechanical Equipment - Scheduling	Mechanical Equipment - Scheduling
1318	Mechanical Equipment - Scheduling	Mechanical	Mechanical Equipment - Scheduling	Mechanical Equipment - Scheduling
1319	Mechanical Equipment - Skid Mounted Equipment	Mechanical	Mechanical Equipment - Skid Mounted Equipment	Mechanical Equipment - Skid Mounted Equipment
1320	Mechanical Equipment - Skid Mounted Equipment	Mechanical	Mechanical Equipment - Skid Mounted Equipment	Mechanical Equipment - Skid Mounted Equipment
1321	Mechanical Equipment - Skid Mounted Equipment	Mechanical	Mechanical Equipment - Skid Mounted Equipment	Mechanical Equipment - Skid Mounted Equipment
1322	Mechanical Equipment - Start-up	Mechanical	Mechanical Equipment - Start-up	Mechanical Equipment - Start-up
1323	Mechanical Equipment - Storage & Maintenance	Mechanical	Mechanical Equipment - Storage & Maintenance	Mechanical Equipment - Storage & Maintenance

1324	Mechanical Equipment - Storage & Maintenance	Mechanical	Mechanical Equipment - Storage & Maintenance	Mechanical Equipment - Storage & Maintenance
1325	Mechanical Equipment - Storage & Maintenance	Mechanical	Mechanical Equipment - Storage & Maintenance	Mechanical Equipment - Storage & Maintenance
1326	Mechanical Equipment - Storage & Maintenance	Mechanical	Mechanical Equipment - Storage & Maintenance	Mechanical Equipment - Storage & Maintenance
1327	Mechanical Equipment - Storage & Maintenance	Mechanical	Mechanical Equipment - Storage & Maintenance	Mechanical Equipment - Storage & Maintenance
1328	Mechanical Equipment - Storage & Maintenance	Mechanical	Mechanical Equipment - Storage & Maintenance	Mechanical Equipment - Storage & Maintenance
1329	Mechanical Equipment - Storage & Maintenance	Mechanical	Mechanical Equipment - Storage & Maintenance	Mechanical Equipment - Storage & Maintenance
1330	Mechanical Equipment - Transportation, Lifting & Handling	Mechanical	Mechanical Equipment - Transportation, Lifting & Handling	Mechanical Equipment - Transportation, Lifting & Handling
1331	Mechanical Equipment - Transportation, Lifting & Handling	Mechanical	Mechanical Equipment - Transportation, Lifting & Handling	Mechanical Equipment - Transportation, Lifting & Handling
1332	Mechanical Equipment - Transportation, Lifting & Handling	Mechanical	Mechanical Equipment - Transportation, Lifting & Handling	Mechanical Equipment - Transportation, Lifting & Handling
1333	Mechanical Equipment - Transportation, Lifting & Handling	Mechanical	Mechanical Equipment - Transportation, Lifting & Handling	Mechanical Equipment - Transportation, Lifting & Handling
1334	Mechanical Equipment - Transportation, Lifting & Handling	Mechanical	Mechanical Equipment - Transportation, Lifting & Handling	Mechanical Equipment - Transportation, Lifting & Handling
1335	Mechanical Equipment - Transportation, Lifting & Handling	Mechanical	Mechanical Equipment - Transportation, Lifting & Handling	Mechanical Equipment - Transportation, Lifting & Handling
1336	Mechanical Equipment - Transportation, Lifting & Handling	Mechanical	Mechanical Equipment - Transportation, Lifting & Handling	Mechanical Equipment - Transportation, Lifting & Handling
1337	Mechanical Equipment - Transportation, Lifting & Handling	Mechanical	Mechanical Equipment - Transportation, Lifting & Handling	Mechanical Equipment - Transportation, Lifting & Handling

1338	Mechanical Equipment - Transportation, Lifting & Handling	Mechanical	Mechanical Equipment - Transportation, Lifting & Handling	Mechanical Equipment - Transportation, Lifting & Handling
1339	Mechanical Equipment - Transportation, Lifting & Handling	Mechanical	Mechanical Equipment - Transportation, Lifting & Handling	Mechanical Equipment - Transportation, Lifting & Handling
1340	Mechanical Equipment - Vessels	Mechanical	Mechanical Equipment - Vessels	Mechanical Equipment - Vessels
1341	Mechanical Equipment - Vessels	Mechanical	Mechanical Equipment - Vessels	Mechanical Equipment - Vessels
1342	Mechanical Equipment - Vessels	Mechanical	Mechanical Equipment - Vessels	Mechanical Equipment - Vessels
1343	Mechanical Equipment - Vessels	Mechanical	Mechanical Equipment - Vessels	Mechanical Equipment - Vessels
1344	Mechanical Equipment - Vessels	Mechanical	Mechanical Equipment - Vessels	Mechanical Equipment - Vessels
1345	Mechanical Equipment - Vessels	Mechanical	Mechanical Equipment - Vessels	Mechanical Equipment - Vessels
1346	Mechanical Equipment - Vessels	Mechanical	Mechanical Equipment - Vessels	Mechanical Equipment - Vessels
1347	Mechanical Equipment - Vessels	Mechanical	Mechanical Equipment - Vessels	Mechanical Equipment - Vessels
1348	Mechanical Equipment - Vessels	Mechanical	Mechanical Equipment - Vessels	Mechanical Equipment - Vessels
1349	Mechanical Equipment - Vessels	Mechanical	Mechanical Equipment - Vessels	Mechanical Equipment - Vessels
1350	Mechanical Equipment - Vessels	Mechanical	Mechanical Equipment - Vessels	Mechanical Equipment - Vessels
1351	Mechanical Equipment - Vessels	Mechanical	Mechanical Equipment - Vessels	Mechanical Equipment - Vessels
1352	Piping - Bolts & Gaskets	Mechanical	Piping - Bolts & Gaskets	Piping - Bolts & Gaskets
1353	Piping - Bolts & Gaskets	Mechanical	Piping - Bolts & Gaskets	Piping - Bolts & Gaskets
1354	Piping - Design Considerations	Mechanical	Piping - Design Considerations	Piping - Design Considerations
1355	Piping - Design Considerations	Mechanical	Piping - Design Considerations	Piping - Design Considerations

1356	Piping - Design Considerations	Mechanical	Piping - Design Considerations	Piping - Design Considerations
1357	Piping - Design Considerations	Mechanical	Piping - Design Considerations	Piping - Design Considerations
1358	Piping - Design Considerations	Mechanical	Piping - Design Considerations	Piping - Design Considerations
1359	Piping - Design Considerations	Mechanical	Piping - Design Considerations	Piping - Design Considerations
1360	Piping - Design Considerations	Mechanical	Piping - Design Considerations	Piping - Design Considerations
1361	Piping - Design Considerations	Mechanical	Piping - Design Considerations	Piping - Design Considerations
1362	Piping - Design Considerations	Mechanical	Piping - Design Considerations	Piping - Design Considerations
1363	Piping - Design Considerations	Mechanical	Piping - Design Considerations	Piping - Design Considerations
1364	Piping - Design Considerations	Mechanical	Piping - Design Considerations	Piping - Design Considerations
1365	Piping - Design Considerations	Mechanical	Piping - Design Considerations	Piping - Design Considerations
1366	Piping - Design Considerations	Mechanical	Piping - Design Considerations	Piping - Design Considerations
1367	Piping - Design Considerations	Mechanical	Piping - Design Considerations	Piping - Design Considerations
1368	Piping - Design Considerations	Mechanical	Piping - Design Considerations	Piping - Design Considerations
1369	Piping - Design Considerations	Mechanical	Piping - Design Considerations	Piping - Design Considerations
1370	Piping - Design Considerations	Mechanical	Piping - Design Considerations	Piping - Design Considerations
1371	Piping - Design Considerations	Mechanical	Piping - Design Considerations	Piping - Design Considerations
1372	Piping - Drawings, Specification & Electronic Models	Mechanical	Piping - Drawings, Specification & Electronic Models	Piping - Drawings, Specification & Electronic Models
1373	Piping - Drawings, Specification & Electronic Models	Mechanical	Piping - Drawings, Specification & Electronic Models	Piping - Drawings, Specification & Electronic Models

1374	Piping - Drawings, Specification & Electronic Models	Mechanical	Piping - Drawings, Specification & Electronic Models	Piping - Drawings, Specification & Electronic Models
1375	Piping - Drawings, Specification & Electronic Models	Mechanical	Piping - Drawings, Specification & Electronic Models	Piping - Drawings, Specification & Electronic Models
1376	Piping - Drawings, Specification & Electronic Models	Mechanical	Piping - Drawings, Specification & Electronic Models	Piping - Drawings, Specification & Electronic Models
1377	Piping - Drawings, Specification & Electronic Models	Mechanical	Piping - Drawings, Specification & Electronic Models	Piping - Drawings, Specification & Electronic Models
1378	Piping - Drawings, Specification & Electronic Models	Mechanical	Piping - Drawings, Specification & Electronic Models	Piping - Drawings, Specification & Electronic Models
1379	Piping - Drawings, Specification & Electronic Models	Mechanical	Piping - Drawings, Specification & Electronic Models	Piping - Drawings, Specification & Electronic Models
1380	Piping - Drawings, Specification & Electronic Models	Mechanical	Piping - Drawings, Specification & Electronic Models	Piping - Drawings, Specification & Electronic Models
1381	Piping - Drawings, Specification & Electronic Models	Mechanical	Piping - Drawings, Specification & Electronic Models	Piping - Drawings, Specification & Electronic Models
1382	Piping - Drawings, Specification & Electronic Models	Mechanical	Piping - Drawings, Specification & Electronic Models	Piping - Drawings, Specification & Electronic Models
1383	Piping - Drawings, Specification & Electronic Models	Mechanical	Piping - Drawings, Specification & Electronic Models	Piping - Drawings, Specification & Electronic Models
1384	Piping - Drawings, Specification & Electronic Models	Mechanical	Piping - Drawings, Specification & Electronic Models	Piping - Drawings, Specification & Electronic Models
1385	Piping - Drawings, Specification & Electronic Models	Mechanical	Piping - Drawings, Specification & Electronic Models	Piping - Drawings, Specification & Electronic Models
1386	Piping - Drawings, Specification & Electronic Models	Mechanical	Piping - Drawings, Specification & Electronic Models	Piping - Drawings, Specification & Electronic Models
1387	Piping - Drawings, Specification & Electronic Models	Mechanical	Piping - Drawings, Specification & Electronic Models	Piping - Drawings, Specification & Electronic Models

1388	Piping - Drawings, Specification & Electronic Models	Mechanical	Piping - Drawings, Specification & Electronic Models	Piping - Drawings, Specification & Electronic Models
1389	Piping - Drawings, Specification & Electronic Models	Mechanical	Piping - Drawings, Specification & Electronic Models	Piping - Drawings, Specification & Electronic Models
1390	Piping - Drawings, Specification & Electronic Models	Mechanical	Piping - Drawings, Specification & Electronic Models	Piping - Drawings, Specification & Electronic Models
1391	Piping - Drawings, Specification & Electronic Models	Mechanical	Piping - Drawings, Specification & Electronic Models	Piping - Drawings, Specification & Electronic Models
1392	Piping - Drawings, Specification & Electronic Models	Mechanical	Piping - Drawings, Specification & Electronic Models	Piping - Drawings, Specification & Electronic Models
1393	Piping - Drawings, Specification & Electronic Models	Mechanical	Piping - Drawings, Specification & Electronic Models	Piping - Drawings, Specification & Electronic Models
1394	Piping - Drawings, Specification & Electronic Models	Mechanical	Piping - Drawings, Specification & Electronic Models	Piping - Drawings, Specification & Electronic Models
1395	Piping - Drawings, Specification & Electronic Models	Mechanical	Piping - Drawings, Specification & Electronic Models	Piping - Drawings, Specification & Electronic Models
1396	Piping - Drawings, Specification & Electronic Models	Mechanical	Piping - Drawings, Specification & Electronic Models	Piping - Drawings, Specification & Electronic Models
1397	Piping - Drawings, Specification & Electronic Models	Mechanical	Piping - Drawings, Specification & Electronic Models	Piping - Drawings, Specification & Electronic Models
1398	Piping - Drawings, Specification & Electronic Models	Mechanical	Piping - Drawings, Specification & Electronic Models	Piping - Drawings, Specification & Electronic Models
1399	Piping - Drawings, Specification & Electronic Models	Mechanical	Piping - Drawings, Specification & Electronic Models	Piping - Drawings, Specification & Electronic Models
1400	Piping - Drawings, Specification & Electronic Models	Mechanical	Piping - Drawings, Specification & Electronic Models	Piping - Drawings, Specification & Electronic Models
1401	Piping - Drawings, Specification & Electronic Models	Mechanical	Piping - Drawings, Specification & Electronic Models	Piping - Drawings, Specification & Electronic Models
1402	Piping - Drawings, Specification & Electronic Models	Mechanical	Piping - Drawings, Specification & Electronic Models	Piping - Drawings, Specification & Electronic Models

1403	Piping - Drawings, Specification & Electronic Models	Mechanical	Piping - Drawings, Specification & Electronic Models	Piping - Drawings, Specification & Electronic Models
1404	Piping - Drawings, Specification & Electronic Models	Mechanical	Piping - Drawings, Specification & Electronic Models	Piping - Drawings, Specification & Electronic Models
1405	Piping - Drawings, Specification & Electronic Models	Mechanical	Piping - Drawings, Specification & Electronic Models	Piping - Drawings, Specification & Electronic Models
1406	Piping - Drawings, Specification & Electronic Models	Mechanical	Piping - Drawings, Specification & Electronic Models	Piping - Drawings, Specification & Electronic Models
1407	Piping - Drawings, Specification & Electronic Models	Mechanical	Piping - Drawings, Specification & Electronic Models	Piping - Drawings, Specification & Electronic Models
1408	Piping - Fabrication	Mechanical	Piping - Fabrication	Piping - Fabrication
1409	Piping - Fabrication	Mechanical	Piping - Fabrication	Piping - Fabrication
1410	Piping - Fabrication	Mechanical	Piping - Fabrication	Piping - Fabrication
1411	Piping - Fabrication	Mechanical	Piping - Fabrication	Piping - Fabrication
1412	Piping - Fabrication	Mechanical	Piping - Fabrication	Piping - Fabrication
1413	Piping - Fabrication	Mechanical	Piping - Fabrication	Piping - Fabrication
1414	Piping - Fabrication	Mechanical	Piping - Fabrication	Piping - Fabrication
1415	Piping - Insulation & Coatings	Mechanical	Piping - Insulation & Coatings	Piping - Insulation & Coatings
1416	Piping - Insulation & Coatings	Mechanical	Piping - Insulation & Coatings	Piping - Insulation & Coatings
1417	Piping - Insulation & Coatings	Mechanical	Piping - Insulation & Coatings	Piping - Insulation & Coatings
1418	Piping - Insulation & Coatings	Mechanical	Piping - Insulation & Coatings	Piping - Insulation & Coatings
1419	Piping - Insulation & Coatings	Mechanical	Piping - Insulation & Coatings	Piping - Insulation & Coatings
1420	Piping - Insulation & Coatings	Mechanical	Piping - Insulation & Coatings	Piping - Insulation & Coatings

1421	Piping - Marking & Identification	Mechanical	Piping - Marking & Identification	Piping - Marking & Identification
1422	Piping - Marking & Identification	Mechanical	Piping - Marking & Identification	Piping - Marking & Identification
1423	Piping - Marking & Identification	Mechanical	Piping - Marking & Identification	Piping - Marking & Identification
1424	Piping - Marking & Identification	Mechanical	Piping - Marking & Identification	Piping - Marking & Identification
1425	Piping - Materials	Mechanical	Piping - Materials	Piping - Materials
1426	Piping - Materials	Mechanical	Piping - Materials	Piping - Materials
1427	Piping - Materials	Mechanical	Piping - Materials	Piping - Materials
1428	Piping - Materials	Mechanical	Piping - Materials	Piping - Materials
1429	Piping - Materials	Mechanical	Piping - Materials	Piping - Materials
1430	Piping - Materials	Mechanical	Piping - Materials	Piping - Materials
1431	Piping - Materials	Mechanical	Piping - Materials	Piping - Materials
1432	Piping - Materials	Mechanical	Piping - Materials	Piping - Materials
1433	Piping - Materials	Mechanical	Piping - Materials	Piping - Materials
1434	Piping - Materials	Mechanical	Piping - Materials	Piping - Materials
1435	Piping - Materials	Mechanical	Piping - Materials	Piping - Materials
1436	Piping - Materials	Mechanical	Piping - Materials	Piping - Materials
1437	Piping - Materials	Mechanical	Piping - Materials	Piping - Materials
1438	Piping - Piping Tie-Ins	Mechanical	Piping - Piping Tie-Ins	Piping - Piping Tie-Ins
1439	Piping - Piping Tie-Ins	Mechanical	Piping - Piping Tie-Ins	Piping - Piping Tie-Ins
1440	Piping - Piping Tie-Ins	Mechanical	Piping - Piping Tie-Ins	Piping - Piping Tie-Ins
1441	Piping - Piping Tie-Ins	Mechanical	Piping - Piping Tie-Ins	Piping - Piping Tie-Ins

1442	Piping - Piping Tie-Ins	Mechanical	Piping - Piping Tie-Ins	Piping - Piping Tie-Ins
1443	Piping - Scheduling	Mechanical	Piping - Scheduling	Piping - Scheduling
1444	Piping - Scheduling	Mechanical	Piping - Scheduling	Piping - Scheduling
1445	Piping - Scheduling	Mechanical	Piping - Scheduling	Piping - Scheduling
1446	Piping - Scheduling	Mechanical	Piping - Scheduling	Piping - Scheduling
1447	Piping - Scheduling	Mechanical	Piping - Scheduling	Piping - Scheduling
1448	Piping - Scheduling	Mechanical	Piping - Scheduling	Piping - Scheduling
1449	Piping - Scheduling	Mechanical	Piping - Scheduling	Piping - Scheduling
1450	Piping - Scheduling	Mechanical	Piping - Scheduling	Piping - Scheduling
1451	Piping - Scheduling	Mechanical	Piping - Scheduling	Piping - Scheduling
1452	Piping - Scheduling	Mechanical	Piping - Scheduling	Piping - Scheduling
1453	Piping - Supports & Restraints	Mechanical	Piping - Supports & Restraints	Piping - Supports & Restraints
1454	Piping - Supports & Restraints	Mechanical	Piping - Supports & Restraints	Piping - Supports & Restraints
1455	Piping - Supports & Restraints	Mechanical	Piping - Supports & Restraints	Piping - Supports & Restraints
1456	Piping - Supports & Restraints	Mechanical	Piping - Supports & Restraints	Piping - Supports & Restraints
1457	Piping - Supports & Restraints	Mechanical	Piping - Supports & Restraints	Piping - Supports & Restraints
1458	Piping - Supports & Restraints	Mechanical	Piping - Supports & Restraints	Piping - Supports & Restraints
1459	Piping - Supports & Restraints	Mechanical	Piping - Supports & Restraints	Piping - Supports & Restraints
1460	Piping - Supports & Restraints	Mechanical	Piping - Supports & Restraints	Piping - Supports & Restraints
1461	Piping - Supports & Restraints	Mechanical	Piping - Supports & Restraints	Piping - Supports & Restraints

1462	Piping - Supports & Restraints	Mechanical	Piping - Supports & Restraints	Piping - Supports & Restraints
1463	Piping - Supports & Restraints	Mechanical	Piping - Supports & Restraints	Piping - Supports & Restraints
1464	Piping - Supports & Restraints	Mechanical	Piping - Supports & Restraints	Piping - Supports & Restraints
1465	Piping - Supports & Restraints	Mechanical	Piping - Supports & Restraints	Piping - Supports & Restraints
1466	Piping - Supports & Restraints	Mechanical	Piping - Supports & Restraints	Piping - Supports & Restraints
1467	Piping - Supports & Restraints	Mechanical	Piping - Supports & Restraints	Piping - Supports & Restraints
1468	Piping - Testing & Cleaning	Mechanical	Piping - Testing & Cleaning	Piping - Testing & Cleaning
1469	Piping - Testing & Cleaning	Mechanical	Piping - Testing & Cleaning	Piping - Testing & Cleaning
1470	Piping - Testing & Cleaning	Mechanical	Piping - Testing & Cleaning	Piping - Testing & Cleaning
1471	Piping - Testing & Cleaning	Mechanical	Piping - Testing & Cleaning	Piping - Testing & Cleaning
1472	Piping - Testing & Cleaning	Mechanical	Piping - Testing & Cleaning	Piping - Testing & Cleaning
1473	Piping - Testing & Cleaning	Mechanical	Piping - Testing & Cleaning	Piping - Testing & Cleaning
1474	Piping - Testing & Cleaning	Mechanical	Piping - Testing & Cleaning	Piping - Testing & Cleaning
1475	Piping - Testing & Cleaning	Mechanical	Piping - Testing & Cleaning	Piping - Testing & Cleaning
1476	Piping - Testing & Cleaning	Mechanical	Piping - Testing & Cleaning	Piping - Testing & Cleaning
1477	Piping - Turnover	Mechanical	Piping - Turnover	Piping - Turnover

1478	Piping - Turnover	Mechanical	Piping - Turnover	Piping - Turnover
1479	Piping - Turnover	Mechanical	Piping - Turnover	Piping - Turnover
1480	Piping - Underground	Mechanical	Piping - Underground	Piping - Underground
1481	Piping - Underground	Mechanical	Piping - Underground	Piping - Underground
1482	Piping - Underground	Mechanical	Piping - Underground	Piping - Underground
1483	Piping - Underground	Mechanical	Piping - Underground	Piping - Underground
1484	Piping - Underground	Mechanical	Piping - Underground	Piping - Underground
1485	Piping - Underground	Mechanical	Piping - Underground	Piping - Underground
1486	Piping - Welding	Mechanical	Piping - Welding	Piping - Welding
1487	Piping - Welding	Mechanical	Piping - Welding	Piping - Welding
1488	Piping - Welding	Mechanical	Piping - Welding	Piping - Welding
1489	Piping - Welding	Mechanical	Piping - Welding	Piping - Welding
1490	Piping - Welding	Mechanical	Piping - Welding	Piping - Welding
1491	Piping - Welding	Mechanical	Piping - Welding	Piping - Welding
1492	Piping - Welding	Mechanical	Piping - Welding	Piping - Welding
1493	Plot Plan & Equipment Arrangement - Civil & Concrete	Civil	Plot Plan & Equipment Arrangement - Civil & Concrete	Plot Plan & Equipment Arrangement - Civil & Concrete
1494	Plot Plan & Equipment Arrangement - Civil & Concrete	Civil	Plot Plan & Equipment Arrangement - Civil & Concrete	Plot Plan & Equipment Arrangement - Civil & Concrete
1495	Plot Plan & Equipment Arrangement - Civil & Concrete	Civil	Plot Plan & Equipment Arrangement - Civil & Concrete	Plot Plan & Equipment Arrangement - Civil & Concrete

1496	Plot Plan & Equipment Arrangement - Equipment Accessibility	Other	Plot Plan & Equipment Arrangement - Equipment Accessibility	Plot Plan & Equipment Arrangement - Equipment Accessibility
1497	Plot Plan & Equipment Arrangement - Equipment Accessibility	Other	Plot Plan & Equipment Arrangement - Equipment Accessibility	Plot Plan & Equipment Arrangement - Equipment Accessibility
1498	Plot Plan & Equipment Arrangement - Equipment Accessibility	Other	Plot Plan & Equipment Arrangement - Equipment Accessibility	Plot Plan & Equipment Arrangement - Equipment Accessibility
1499	Plot Plan & Equipment Arrangement - Equipment Accessibility	Other	Plot Plan & Equipment Arrangement - Equipment Accessibility	Plot Plan & Equipment Arrangement - Equipment Accessibility
1500	Plot Plan & Equipment Arrangement - Equipment Accessibility	Other	Plot Plan & Equipment Arrangement - Equipment Accessibility	Plot Plan & Equipment Arrangement - Equipment Accessibility
1501	Plot Plan & Equipment Arrangement - Equipment Accessibility	Other	Plot Plan & Equipment Arrangement - Equipment Accessibility	Plot Plan & Equipment Arrangement - Equipment Accessibility
1502	Plot Plan & Equipment Arrangement - Equipment Accessibility	Other	Plot Plan & Equipment Arrangement - Equipment Accessibility	Plot Plan & Equipment Arrangement - Equipment Accessibility
1503	Plot Plan & Equipment Arrangement - Equipment Accessibility	Other	Plot Plan & Equipment Arrangement - Equipment Accessibility	Plot Plan & Equipment Arrangement - Equipment Accessibility
1504	Plot Plan & Equipment Arrangement - Equipment Accessibility	Other	Plot Plan & Equipment Arrangement - Equipment Accessibility	Plot Plan & Equipment Arrangement - Equipment Accessibility
1505	Plot Plan & Equipment Arrangement - Equipment Accessibility	Other	Plot Plan & Equipment Arrangement - Equipment Accessibility	Plot Plan & Equipment Arrangement - Equipment Accessibility
1506	Plot Plan & Equipment Arrangement - Equipment Accessibility	Other	Plot Plan & Equipment Arrangement - Equipment Accessibility	Plot Plan & Equipment Arrangement - Equipment Accessibility
1507	Plot Plan & Equipment Arrangement - Equipment Accessibility	Other	Plot Plan & Equipment Arrangement - Equipment Accessibility	Plot Plan & Equipment Arrangement - Equipment Accessibility
1508	Plot Plan & Equipment Arrangement - Equipment Accessibility	Other	Plot Plan & Equipment Arrangement - Equipment Accessibility	Plot Plan & Equipment Arrangement - Equipment Accessibility
1509	Plot Plan & Equipment Arrangement - Equipment Accessibility	Other	Plot Plan & Equipment Arrangement - Equipment Accessibility	Plot Plan & Equipment Arrangement - Equipment Accessibility
1510	Plot Plan & Equipment Arrangement - Equipment Accessibility	Other	Plot Plan & Equipment Arrangement - Equipment Accessibility	Plot Plan & Equipment Arrangement - Equipment Accessibility

1511	Plot Plan & Equipment Arrangement - Equipment Accessibility	Other	Plot Plan & Equipment Arrangement - Equipment Accessibility	Plot Plan & Equipment Arrangement - Equipment Accessibility
1512	Plot Plan & Equipment Arrangement - Equipment Accessibility	Other	Plot Plan & Equipment Arrangement - Equipment Accessibility	Plot Plan & Equipment Arrangement - Equipment Accessibility
1513	Plot Plan & Equipment Arrangement - Equipment Accessibility	Other	Plot Plan & Equipment Arrangement - Equipment Accessibility	Plot Plan & Equipment Arrangement - Equipment Accessibility
1514	Plot Plan & Equipment Arrangement - Equipment Accessibility	Other	Plot Plan & Equipment Arrangement - Equipment Accessibility	Plot Plan & Equipment Arrangement - Equipment Accessibility
1515	Plot Plan & Equipment Arrangement - Equipment Accessibility	Other	Plot Plan & Equipment Arrangement - Equipment Accessibility	Plot Plan & Equipment Arrangement - Equipment Accessibility
1516	Plot Plan & Equipment Arrangement - Equipment Accessibility	Other	Plot Plan & Equipment Arrangement - Equipment Accessibility	Plot Plan & Equipment Arrangement - Equipment Accessibility
1517	Plot Plan & Equipment Arrangement - Equipment Accessibility	Other	Plot Plan & Equipment Arrangement - Equipment Accessibility	Plot Plan & Equipment Arrangement - Equipment Accessibility
1518	Plot Plan & Equipment Arrangement - General	Other	Plot Plan & Equipment Arrangement - General	Plot Plan & Equipment Arrangement - General
1519	Plot Plan & Equipment Arrangement - General	Other	Plot Plan & Equipment Arrangement - General	Plot Plan & Equipment Arrangement - General
1520	Plot Plan & Equipment Arrangement - Pipe Racks	Other	Plot Plan & Equipment Arrangement - Pipe Racks	Plot Plan & Equipment Arrangement - Pipe Racks
1521	Plot Plan & Equipment Arrangement - Pipe Racks	Other	Plot Plan & Equipment Arrangement - Pipe Racks	Plot Plan & Equipment Arrangement - Pipe Racks
1522	Plot Plan & Equipment Arrangement - Safety	Other	Plot Plan & Equipment Arrangement - Safety	Plot Plan & Equipment Arrangement - Safety
1523	Plot Plan & Equipment Arrangement - Safety	Other	Plot Plan & Equipment Arrangement - Safety	Plot Plan & Equipment Arrangement - Safety
1524	Plot Plan & Equipment Arrangement - Safety	Other	Plot Plan & Equipment Arrangement - Safety	Plot Plan & Equipment Arrangement - Safety
1525	Plot Plan & Equipment Arrangement - Safety	Other	Plot Plan & Equipment Arrangement - Safety	Plot Plan & Equipment Arrangement - Safety
1526	Plot Plan & Equipment Arrangement - Safety	Other	Plot Plan & Equipment Arrangement - Safety	Plot Plan & Equipment Arrangement - Safety
1527	Plot Plan & Equipment Arrangement - Safety	Other	Plot Plan & Equipment Arrangement - Safety	Plot Plan & Equipment Arrangement - Safety

1528	Plot Plan & Equipment Arrangement - Safety	Other	Plot Plan & Equipment Arrangement - Safety	Plot Plan & Equipment Arrangement - Safety
1529	Plot Plan & Equipment Arrangement - Safety	Other	Plot Plan & Equipment Arrangement - Safety	Plot Plan & Equipment Arrangement - Safety
1530	Plot Plan & Equipment Arrangement - Safety	Other	Plot Plan & Equipment Arrangement - Safety	Plot Plan & Equipment Arrangement - Safety
1531	Plot Plan & Equipment Arrangement - Safety	Other	Plot Plan & Equipment Arrangement - Safety	Plot Plan & Equipment Arrangement - Safety
1532	Plot Plan & Equipment Arrangement - Scheduling	Other	Plot Plan & Equipment Arrangement - Scheduling	Plot Plan & Equipment Arrangement - Scheduling
1533	Plot Plan & Equipment Arrangement - Scheduling	Other	Plot Plan & Equipment Arrangement - Scheduling	Plot Plan & Equipment Arrangement - Scheduling
1534	Plot Plan & Equipment Arrangement - Temporary Facilities	Other	Plot Plan & Equipment Arrangement - Temporary Facilities	Plot Plan & Equipment Arrangement - Temporary Facilities
1535	Plot Plan & Equipment Arrangement - Temporary Facilities	Other	Plot Plan & Equipment Arrangement - Temporary Facilities	Plot Plan & Equipment Arrangement - Temporary Facilities
1536	Plot Plan & Equipment Arrangement - Temporary Facilities	Other	Plot Plan & Equipment Arrangement - Temporary Facilities	Plot Plan & Equipment Arrangement - Temporary Facilities
1537	Plot Plan & Equipment Arrangement - Utilities	Other	Plot Plan & Equipment Arrangement - Utilities	Plot Plan & Equipment Arrangement - Utilities
1538	Plot Plan & Equipment Arrangement - Utilities	Other	Plot Plan & Equipment Arrangement - Utilities	Plot Plan & Equipment Arrangement - Utilities
1539	Plot Plan & Equipment Arrangement - Utilities	Other	Plot Plan & Equipment Arrangement - Utilities	Plot Plan & Equipment Arrangement - Utilities
1540	Plot Plan & Equipment Arrangement - Utilities	Other	Plot Plan & Equipment Arrangement - Utilities	Plot Plan & Equipment Arrangement - Utilities
1541	Plot Plan & Equipment Arrangement - Utilities	Other	Plot Plan & Equipment Arrangement - Utilities	Plot Plan & Equipment Arrangement - Utilities
1542	Procurement and Contracting - Contracts	Admin	Procurement and Contracting - Contracts	Procurement and Contracting - Contracts
1543	Procurement and Contracting - Contracts	Admin	Procurement and Contracting - Contracts	Procurement and Contracting - Contracts
1544	Procurement and Contracting - Contracts	Admin	Procurement and Contracting - Contracts	Procurement and Contracting - Contracts
1545	Procurement and Contracting - Contracts	Admin	Procurement and Contracting - Contracts	Procurement and Contracting - Contracts

1546	Procurement and Contracting - Contracts	Admin	Procurement and Contracting - Contracts	Procurement and Contracting - Contracts
1547	Procurement and Contracting - Contracts	Admin	Procurement and Contracting - Contracts	Procurement and Contracting - Contracts
1548	Procurement and Contracting - Contracts	Admin	Procurement and Contracting - Contracts	Procurement and Contracting - Contracts
1549	Procurement and Contracting - Contracts	Admin	Procurement and Contracting - Contracts	Procurement and Contracting - Contracts
1550	Procurement and Contracting - Contracts	Admin	Procurement and Contracting - Contracts	Procurement and Contracting - Contracts
1551	Procurement and Contracting - Contracts	Admin	Procurement and Contracting - Contracts	Procurement and Contracting - Contracts
1552	Procurement and Contracting - Contracts	Admin	Procurement and Contracting - Contracts	Procurement and Contracting - Contracts
1553	Procurement and Contracting - Contracts	Admin	Procurement and Contracting - Contracts	Procurement and Contracting - Contracts
1554	Procurement and Contracting - Contracts	Admin	Procurement and Contracting - Contracts	Procurement and Contracting - Contracts
1555	Procurement and Contracting - Contracts	Admin	Procurement and Contracting - Contracts	Procurement and Contracting - Contracts
1556	Procurement and Contracting - Contracts	Admin	Procurement and Contracting - Contracts	Procurement and Contracting - Contracts
1557	Procurement and Contracting - Contracts	Admin	Procurement and Contracting - Contracts	Procurement and Contracting - Contracts
1558	Procurement and Contracting - Contracts	Admin	Procurement and Contracting - Contracts	Procurement and Contracting - Contracts
1559	Procurement and Contracting - Contracts	Admin	Procurement and Contracting - Contracts	Procurement and Contracting - Contracts
1560	Procurement and Contracting - Equipment	Admin	Procurement and Contracting - Equipment	Procurement and Contracting - Equipment
1561	Procurement and Contracting - General	Admin	Procurement and Contracting - General	Procurement and Contracting - General
1562	Procurement and Contracting - General	Admin	Procurement and Contracting - General	Procurement and Contracting - General
1563	Procurement and Contracting - General	Admin	Procurement and Contracting - General	Procurement and Contracting - General
1564	Procurement and Contracting - General	Admin	Procurement and Contracting - General	Procurement and Contracting - General

1565	Procurement and Contracting - General	Admin	Procurement and Contracting - General	Procurement and Contracting - General
1566	Procurement and Contracting - General	Admin	Procurement and Contracting - General	Procurement and Contracting - General
1567	Procurement and Contracting - General	Admin	Procurement and Contracting - General	Procurement and Contracting - General
1568	Procurement and Contracting - Piping & Structural Steel	Admin	Procurement and Contracting - Piping & Structural Steel	Procurement and Contracting - Piping & Structural Steel
1569	Procurement and Contracting - Piping & Structural Steel	Admin	Procurement and Contracting - Piping & Structural Steel	Procurement and Contracting - Piping & Structural Steel
1570	Procurement and Contracting - Piping & Structural Steel	Admin	Procurement and Contracting - Piping & Structural Steel	Procurement and Contracting - Piping & Structural Steel
1571	Procurement and Contracting - Piping & Structural Steel	Admin	Procurement and Contracting - Piping & Structural Steel	Procurement and Contracting - Piping & Structural Steel
1572	Procurement and Contracting - Piping & Structural Steel	Admin	Procurement and Contracting - Piping & Structural Steel	Procurement and Contracting - Piping & Structural Steel
1573	Procurement and Contracting - Piping & Structural Steel	Admin	Procurement and Contracting - Piping & Structural Steel	Procurement and Contracting - Piping & Structural Steel
1574	Procurement and Contracting - Piping & Structural Steel	Admin	Procurement and Contracting - Piping & Structural Steel	Procurement and Contracting - Piping & Structural Steel
1575	Procurement and Contracting - Piping & Structural Steel	Admin	Procurement and Contracting - Piping & Structural Steel	Procurement and Contracting - Piping & Structural Steel
1576	Procurement and Contracting - Piping & Structural Steel	Admin	Procurement and Contracting - Piping & Structural Steel	Procurement and Contracting - Piping & Structural Steel
1577	Procurement and Contracting - Piping & Structural Steel	Admin	Procurement and Contracting - Piping & Structural Steel	Procurement and Contracting - Piping & Structural Steel
1578	Procurement and Contracting - Piping & Structural Steel	Admin	Procurement and Contracting - Piping & Structural Steel	Procurement and Contracting - Piping & Structural Steel
1579	Procurement and Contracting - Piping & Structural Steel	Admin	Procurement and Contracting - Piping & Structural Steel	Procurement and Contracting - Piping & Structural Steel
1580	Protective Coatings - Equipment Insulation	Mechanical	Protective Coatings - Equipment Insulation	Protective Coatings - Equipment Insulation

1581	Protective Coatings - Equipment Insulation	Mechanical	Protective Coatings - Equipment Insulation	Protective Coatings - Equipment Insulation
1582	Protective Coatings - General	Mechanical	Protective Coatings - General	Protective Coatings - General
1583	Protective Coatings - General	Mechanical	Protective Coatings - General	Protective Coatings - General
1584	Protective Coatings - General	Mechanical	Protective Coatings - General	Protective Coatings - General
1585	Protective Coatings - General	Mechanical	Protective Coatings - General	Protective Coatings - General
1586	Protective Coatings - Insulation Specification	Mechanical	Protective Coatings - Insulation Specification	Protective Coatings - Insulation Specification
1587	Protective Coatings - Insulation Specification	Mechanical	Protective Coatings - Insulation Specification	Protective Coatings - Insulation Specification
1588	Protective Coatings - Insulation Specification	Mechanical	Protective Coatings - Insulation Specification	Protective Coatings - Insulation Specification
1589	Protective Coatings - Insulation Specification	Mechanical	Protective Coatings - Insulation Specification	Protective Coatings - Insulation Specification
1590	Protective Coatings - Paint Application	Mechanical	Protective Coatings - Paint Application	Protective Coatings - Paint Application
1591	Protective Coatings - Paint Application	Mechanical	Protective Coatings - Paint Application	Protective Coatings - Paint Application
1592	Protective Coatings - Paint Application	Mechanical	Protective Coatings - Paint Application	Protective Coatings - Paint Application
1593	Protective Coatings - Paint Application	Mechanical	Protective Coatings - Paint Application	Protective Coatings - Paint Application
1594	Protective Coatings - Paint Application	Mechanical	Protective Coatings - Paint Application	Protective Coatings - Paint Application
1595	Protective Coatings - Paint Application	Mechanical	Protective Coatings - Paint Application	Protective Coatings - Paint Application
1596	Protective Coatings - Paint Specifications	Mechanical	Protective Coatings - Paint Specifications	Protective Coatings - Paint Specifications
1597	Protective Coatings - Paint Specifications	Mechanical	Protective Coatings - Paint Specifications	Protective Coatings - Paint Specifications
1598	Protective Coatings - Paint Specifications	Mechanical	Protective Coatings - Paint Specifications	Protective Coatings - Paint Specifications
1599	Protective Coatings - Paint Specifications	Mechanical	Protective Coatings - Paint Specifications	Protective Coatings - Paint Specifications
1600	Protective Coatings - Paint Specifications	Mechanical	Protective Coatings - Paint Specifications	Protective Coatings - Paint Specifications

1601	Protective Coatings - Paint Specifications	Mechanical	Protective Coatings - Paint Specifications	Protective Coatings - Paint Specifications
1602	Protective Coatings - Pipe Insulation	Mechanical	Protective Coatings - Pipe Insulation	Protective Coatings - Pipe Insulation
1603	Protective Coatings - Pipe Insulation	Mechanical	Protective Coatings - Pipe Insulation	Protective Coatings - Pipe Insulation
1604	Protective Coatings - Pipe Insulation	Mechanical	Protective Coatings - Pipe Insulation	Protective Coatings - Pipe Insulation
1605	Protective Coatings - Special Insulation Applications	Mechanical	Protective Coatings - Special Insulation Applications	Protective Coatings - Special Insulation Applications
1606	Protective Coatings - Special Insulation Applications	Mechanical	Protective Coatings - Special Insulation Applications	Protective Coatings - Special Insulation Applications
1607	Protective Coatings - Special Insulation Applications	Mechanical	Protective Coatings - Special Insulation Applications	Protective Coatings - Special Insulation Applications
1608	Steel - Fabrication	Civil	Steel - Fabrication	Steel - Fabrication
1609	Steel - Fabrication	Civil	Steel - Fabrication	Steel - Fabrication
1610	Steel - Fabrication	Civil	Steel - Fabrication	Steel - Fabrication
1611	Steel - Fabrication	Civil	Steel - Fabrication	Steel - Fabrication
1612	Steel - Fireproofing & Coating	Civil	Steel - Fireproofing & Coating	Steel - Fireproofing & Coating
1613	Steel - Fireproofing & Coating	Civil	Steel - Fireproofing & Coating	Steel - Fireproofing & Coating
1614	Steel - Fireproofing & Coating	Civil	Steel - Fireproofing & Coating	Steel - Fireproofing & Coating
1615	Steel - Fireproofing & Coating	Civil	Steel - Fireproofing & Coating	Steel - Fireproofing & Coating
1616	Steel - Fireproofing & Coating	Civil	Steel - Fireproofing & Coating	Steel - Fireproofing & Coating
1617	Steel - Fireproofing & Coating	Civil	Steel - Fireproofing & Coating	Steel - Fireproofing & Coating
1618	Steel - Fireproofing & Coating	Civil	Steel - Fireproofing & Coating	Steel - Fireproofing & Coating
1619	Steel - Fireproofing & Coating	Civil	Steel - Fireproofing & Coating	Steel - Fireproofing & Coating
1620	Steel - General	Civil	Steel - General	Steel - General
1621	Steel - General	Civil	Steel - General	Steel - General

1622	Steel - Pre-Assembly	Civil	Steel - Pre-Assembly	Steel - Pre-Assembly
1623	Steel - Pre-Assembly	Civil	Steel - Pre-Assembly	Steel - Pre-Assembly
1624	Steel - Pre-Assembly	Civil	Steel - Pre-Assembly	Steel - Pre-Assembly
1625	Steel - Stairs, Ladders & Platforms	Civil	Steel - Stairs, Ladders & Platforms	Steel - Stairs, Ladders & Platforms
1626	Steel - Stairs, Ladders & Platforms	Civil	Steel - Stairs, Ladders & Platforms	Steel - Stairs, Ladders & Platforms
1627	Steel - Stairs, Ladders & Platforms	Civil	Steel - Stairs, Ladders & Platforms	Steel - Stairs, Ladders & Platforms
1628	Steel - Stairs, Ladders & Platforms	Civil	Steel - Stairs, Ladders & Platforms	Steel - Stairs, Ladders & Platforms
1629	Steel - Stairs, Ladders & Platforms	Civil	Steel - Stairs, Ladders & Platforms	Steel - Stairs, Ladders & Platforms
1630	Steel - Stairs, Ladders & Platforms	Civil	Steel - Stairs, Ladders & Platforms	Steel - Stairs, Ladders & Platforms
1631	Steel - Stairs, Ladders & Platforms	Civil	Steel - Stairs, Ladders & Platforms	Steel - Stairs, Ladders & Platforms
1632	Roof edges (construction, maintenance)	Architectural	Building exterior	Falling
1633	Pre-engineered metal building roofs	Architectural	Building exterior	Falling.
1634	Roof openings (hatches, skylights, shafts, equipment openings)	Architectural	Building exterior	Falling
1635	Roof access	Architectural	Building exterior	Falling
1636	Blind exit passageways, vehicular exit ways	Architectural	Building exterior	Struck by
1637	Loose materials and equipment	Architectural	Building exterior	Struck by
1638	Changes in roof elevations	Architectural	Building exterior	Falling
1639	Vehicular deck load limits	Architectural	Building exterior	Structural failure

1640	Exterior stairs, ramps, pedestrian walks	Architectural	Building exterior	Slipping, falling
1641	Snow, ice accumulation	Architectural	Building exterior	Slipping, falling
1642	Dock door edge protection	Architectural	Building exterior	Falling
1643	Impact resistance at openings	Architectural	Building exterior	Struck by
1644	Window washing	Architectural	Building exterior	Falling
1645	Emergency building evacuation	Architectural	Building exterior	Lack of safe havens
1646	Furnishings general	Architectural	Furninshings and Equipment	Overturning, falling, cuts
1647	Cabinet/locker door handles	Architectural	Furninshings and Equipment	Struck by
1648	Hoists and cranes	Architectural	Furninshings and Equipment	Struck by
1649	Playground equipment	Architectural	Furninshings and Equipment	Falling, caught between
1650	Furnishings/equipment in seismic areas	Architectural	Furninshings and Equipment	Struck by
1651	Mezzanine deck load limits	Architectural	Building interior	Structural failure
1652	Forklift circulation	Architectural	Building interior	Struck by
1653	Floor level changes	Architectural	Building interior	Tripping, falling
1654	Floor expansion joints	Architectural	Building interior	Tripping, falling
1655	Finish material change.	Architectural	Building interior	Tripping.
1656	Stair tread and landing nosings	Architectural	Building interior	Tripping, falling
1657	Low headroom protrusions	Architectural	Building interior	Struck by
1658	Confined spaces	Architectural	Building interior	Caught against
1659	Welding areas, arc flash	Architectural	Building interior	Burns, asphyxiation, eye damage
1660	Dust generating environments	Architectural	Building interior	Explosion
1661	Smoke generating materials	Architectural	Building interior	Asphyxiation

1662	Harmful emissions from finishes (paint voc's, carpet, etc.)	Architectural	Building interior	Respiratory illness
1663	Floor opening	Architectural	Building interior	Fall from elevation
1664	Flooring in wet areas (exterior tile, wash down areas, kitchens, etc.)	Architectural	General	Slipping
1665	Blind door swings	Architectural	General	Struck by, caught against
1666	Presence of dangerous materials (acid waste, asbestos, bio-hazard, poisons, lab waste)	Architectural	General	Burns, contamination, asphyxiation, poisoning
1667	Fixed ladders	Architectural	General	Falling
1668	Low planter walls in pedestrian areas	Architectural	General	Tripping, falling
1669	Parking garage personal safety	Architectural	General	Personal attack
1670	Lock-in, lock-out	Architectural	General	Trapped for extended periods
1671	Handrail design	Architectural	General	Caught, cut
1672	Door sidelights	Architectural	General	Run into
1673	Balcony railings, open stairs	Architectural	General	Falling
1674	Overhead construction	Architectural	General	Falling, struck by
1675	Floor plan layout	Architectural	General	Falling
1676	Tornado protection	Architectural	General	Wind blown debris
1677	Isolated structures	Architectural	General	Personal safety in emergencies
1678	Demolition	Architectural	General	Collapse
1679	Clearances	Electrical	Lighting	Trapped by electrical fire
1680	Parking structures	Electrical	Lighting	Personal safety
1681	Attics, crawl spaces, catwalks, mezzanines	Electrical	Lighting	Fall
1682	Roof with equipment	Electrical	Lighting	Fall

1683	Floor level changes in elevation	Electrical	Lighting	Tripping, falls
1684	Electrical luminaires in seismic areas	Electrical	Lighting	Struck by
1685	All lighting in stairwells	Electrical	Lighting	Fall
1686	High location luminaires	Electrical	Lighting	Fall
1687	Temporary lighting	Electrical	Lighting	Fall
1688	Site/ground mounted lighting	Electrical	Lighting	Burn
1689	Lighting control points for first employee or power outage	Electrical	Lighting	Fall
1690	Clearances	Electrical	Power	Trapped by electrical fire
1691	Isolated structures	Electrical	Power	Personal safety in emergency
1692	Window washing	Electrical	Power	Electrocution
1693	Pedestal type floor mounted electrical devices	Electrical	Power	Trip
1694	Wet areas electrical devices	Electrical	Power	Electrocution
1695	Explosion hazard electrical devices	Electrical	Power	Explosion
1696	Snow melting of handicap pathways	Electrical	Power	Fall
1697	Lockout provisions	Electrical	Power	Electrocution
1698	Disconnects and controls identification	Electrical	Power	Electrocution
1699	Electrical equipment in shops, process, refrigeration rooms	Electrical	Power	Electrocution, fire
1700	Electrical equipment in seismic areas	Electrical	Power	Struck by
1701	Temporary power, portable welders, generator receptacles	Electrical	Power	Electrocution
1702	Energized electrical equipment (including data/signal systems over 50V)	Electrical	Power	Electrocution
1703	Energized electrical equipment	Electrical	Power	Electrocution

1704	Grounding	Electrical	Power	Electrocution
1705	High mounted electrical equipment/ systems	Electrical	Power	Fall
1706	Large equipment delivery	Electrical	Power	Caught by
1707	Start-up	Electrical	Power	Electrocution
1708	Clearances	Electrical	Site	Trapped by electrical fire
1709	Steep slopes and embankments	Electrical	Site	Service vehicle and pedestrian falls
1710	Outdoor transformers, switchboards, and generators	Electrical	Site	Terrorist attacks
1711	Outdoor transformers, switchboards, and generators	Electrical	Site	Electrocution
1712	Manholes - potential fume build-up	Electrical	Site	Asphyxiation
1713	Overhead power line conflicts	Electrical	Site	Electrocution
1714	UG utility lines	Electrical	Site	Cave-ins
1715	UG utility lines	Electrical	Site	Electrocution
1716	Site parking lot	Electrical	Site	Personal safety
1717	Site parking lot at changes in elevation	Electrical	Site	Falls
1718	Clearances	Electrical	Systems	Trapped by electrical fire
1719	Isolated structures	Electrical	Systems	Personal safety in emergency
1720	Pedestal type floor mounted data/voice devices	Electrical	Systems	Trip
1721	Electrical system equipment in seismic areas	Electrical	Systems	Struck by
1722	Card readers/key pads	Electrical	Systems	Personal safety
1723	Fire alarm, security systems, CCTV systems	Electrical	Systems	Personal safety
1724	Exterior alarms	Electrical	Systems	Personal safety
1725	High mounted electrical equipment/ systems	Electrical	Systems	Fall
1726	Large equipment delivery	Electrical	Systems	Caught by

1727	Moving equipment that can cause crushing injuries such as fans and pumps.	Mechanical	Mechanical	Caught in/between [Struck by /Against/Caught]
1728	Buried in trench while installing underground utilities.	Mechanical	Mechanical	Cave-in [Cave-Ins]
1729	Trapped in a large vessel such as storage tank or manhole.	Mechanical	Mechanical	Confined space [Asphyxiation - Confined Space]
1730	Mechanical equipment sparking or electrical components arcing in explosive environments.	Mechanical	Mechanical	Explosion
1731	Shocked while maintaining electrical components of mechanical equipment such as duct heaters and exhaust fans.	Mechanical	Mechanical	Electrical shock [Electrocution]
1732	Infection caused by legionella in domestic hot water system.	Mechanical	Mechanical	Environmental climate (infection)
1733	Hearing loss due to excessively noisy equipment	Mechanical	Mechanical	Environmental climate (noise)
1734	Falling off of roof while repairing or maintaining mechanical equipment.	Mechanical	Mechanical	Falls [Slips/Falls]
1735	Fumes from equipment that contain toxic gases such as some refrigerants.	Mechanical	Mechanical	Toxic substances (respiratory system damage or asphyxiation)

1736	Respiratory system damage resulting from off-gassing of chemical such as volatile organic compounds from caulks and adhesives.	Mechanical	Mechanical	Toxic substances
1737	Scalding from domestic hot water.	Mechanical	Mechanical	Fire (burns)
1738	Burned from hot relief or exhaust discharge.	Mechanical	Mechanical	Fire (burns)
1739	Fall into or through mechanical equipment floor or roof opening.	Mechanical	Mechanical	Fall
1740	Slipping on wet floor such as in mechanical room	Mechanical	Mechanical	Fall (slipping)
1741	Slips/Falls	Civil	Structural - building usage	Exposed concrete floor finish in wet areas could pose slip/fall hazard
1742	Slips/Falls	Civil	Structural - building usage	Inadequate edge protection could cause maintenance workers falling off roofs
1743	Slips/Falls	Civil	Structural - building usage	Wet stairs or extremely smooth stair tread surfaces could pose slip/fall hazard
1744	Slips/Falls	Civil	Structural - building usage	Unmarked steps in top of slab elevations could pose slip/fall hazard
1745	Slips/Falls	Civil	Structural - building usage	Roof top screen wall can have diagonal steel tripping hazards and be too close to the units to safely walk around
1746	Falls From Elevation	Civil	Structural - building usage	Inadequate or no detailing to support window washing rigging could lead to window washer falls.
1747	Falls From Elevation	Civil	Structural - building usage	Inadequate detailing or design of handrails and guards could lead to railing failure
1748	Falls from elevation	Civil	Structural - building usage	Someone falling through a skylight opening could be seriously hurt.
1749	Fire	Civil	Structural - building usage	Inadequate or incomplete fireproofing installation could cause premature building failure or weakening during a fire

1750	Terrorist activity	Civil	Structural - building usage	Exploding bomb may cause significant portion of the building structure to collapse
1751	Personal safety/security	Civil	Structural - building usage	Columns and walls improperly located or located in areas with low lighting levels provide intruder hiding locations
1752	Vehicular Safety	Civil	Structural - building usage	Finish on traffic topping and waterproofing could pose automobile skidding hazard
1753	Vehicular Safety	Civil	Structural - building usage	Columns in parking garages can be hit by vehicles
1754	Vehicular Safety	Civil	Structural - building usage	Columns in warehouses can be damaged by forktrucks
1755	Falling debris	Civil	Structural - building usage	Items hard connected across expansion joints make break during building movement
1756	Floor Overloading	Civil	Structural - building usage	Using small rooms and other building areas for heavy storage different than assumed during design can cause floor systems to become overloaded.
1757	Roof joist overloading	Civil	Structural - building usage	Roof not properly designed for mechanical equipment, conveying, cable tray loads
1758	Struck By -Structure Erection	Civil	Structural - construction	Column instability during erection if only two anchor bolt pattern is installed
1759	Struck By - Structure Erection	Civil	Structural - construction	Column splice detail with connection only to the web
1760	Struck By - Structure Erection	Civil	Structural - construction	Joist framing (applies to wood and cold formed metal framing) could collapse if not properly braced and anchored
1761	Falls From Elevation	Civil	Structural - construction	Slab openings/edges provide potential for workers to fall through
1762	Slips/Fall	Civil	Structural - construction	Slab depressions could cause tripping of construction worker
1763	Slips/Fall	Civil	Structural - construction	Deformed anchor bars (DBA's) which are shop applied to perimeter angles pose tripping and erection hazard
1764	Slips/Fall	Civil	Structural - construction	Reinforcing bar placement for slabs and foundations could cause tripping of construction worker
1765	Falls From Elevation	Civil	Structural - construction	Steel structures slab edges provide location where construction worker could fall
1766	Falls From Elevation	Civil	Structural - construction	Steel deck could shift or lift off due to wind if not anchored immediately

1767	Falls From Elevation	Civil	Structural - construction	Poorly compacted soil may not be adequate to support temporary structures such as scaffolding
1768	Placement error	Civil	Structural - construction	Reinforcing bars not properly located in slabs and walls can have dramatic effect on load capacity of the structure
1769	Impalement	Civil	Structural - construction	Construction workers who fall off formwork, could impale themselves on exposed reinforcing bars
1770	Impalement	Civil	Structural - construction	Post-tension cables can injure other workers if jack fitting or cable fails during tensioning
1771	Electrocution	Civil	Structural - construction	Inadequate grounding of the structural steel could lead to electrocution of erectors
1772	Explosion	Civil	Structural - construction	Construction worker/testing agent in drilled shafts could inhale fumes or have possible explosion if fuel smells are present
1773	Collapse	Civil	Structural - construction	Over excavation for structure undermines footings of adjacent structure
1774	Collapse/Structure damage	Civil	Structural - construction	Heavy Construction loads (such as pallets of masonry) can cause structure damage and possibly collapse if not accounted for
1775	Site excavation soils	Civil	Site	Cave-ins
1776	Blind intersections	Civil	Site	Vehicular and pedestrian collisions
1777	Auto and truck safety	Civil	Site	Collisions
1778	Vehicular security barriers	Civil	Site	Terrorist attacks
1779	Soft roadway shoulders	Civil	Site	Equipment overturning
1780	Building entrances	Civil	Site	Slips/Falls
1781	Playground surfacing	Civil	Site	Falls from elevation
1782	Existing utility lines	Civil	Site	Electrocution, soil contamination

1783	Utility lines	Civil	Site	Cave-ins
1784	Manholes	Civil	Site	Asphyxiation - confined space
1785	Steep slopes and embankments	Civil	Site	Vehicular and pedestrian falling
1786	Retaining walls (General)	Civil	Site	Falls from elevation
1787	Retaining walls (Educational)	Civil	Site	Falls from elevation
1788	Stormwater ponds, bodies of water, inlets	Civil	Site	Drowning
1789	Maintenance of traffic	Civil	Site	Demolition hazard, vehicular and pedestrian collisions
1790	Landscaping/ overhead power line conflicts	Civil	Site	Electrocution

Resolution
Research the history of the project site and alert the constructor of the type and location of any hazardous and toxic substances existing on the site. All engineering disciplines should provide input into a drawing showing all undergrounds.
Use access doors which automatically provide a guarded opening when the doors are opened.
For access doors through floors, use doors which immediately provide guarded entry around the hole perimeter when the door is opened.
Design doors to swing away from passageways and platforms when opened.
Design doors to swing open in the direction of exit travel.
Design and schedule doors to be installed late in the construction phase.
Select door hardware that can keep doors in an open position without props or blocking.
Design and schedule new fire doors to be hung as early as possible in the construction phase. In demolition projects, keep existing fire doors in place as long as possible.
Provide door protection such that natural elements (snow, wind, lightning) will not cause unsafe conditions.
Design window sills to be 42 inches minimum above the floor level. Window sills at this height will act as guard rails during construction.
Design window sills at a consistant level throughout the project
Locate wall and roof penetrations early. This will require coordinate with other disciplines,
Coordinate with mechanical person doing HVAC louvers and dampers.
Identify on the drawings where siding will be left out for equipment installation or construction access.
Coordinate shelf angles for fire-rated siding assemblies.
Consider long spanning siding systems to reduce girt requirements.
Consider specifying light gauge framing for openings in siding so that they can be framed by siding contractors.

Specify the proper end flashing to direct water outside of the building.
Consider specifing that the siding contractor will provide boot flashing in siding openings.
Seal the top edge to prevent moisture infiltrations and and condensation.
Locate roof-to-wall curb transitions such that condensate from siding and water run-off are directed to the outside of the building.
Specify the siding contractor will furnish and install expand-o-flash materials for roof to wall transitions.
Evaluate with the project team and plant representative the advantages and disadvantages of steel and aluminum application areas.
Drawing detail should show at least 1/2 inch between bottom edge of siding and the flashing.
Bar extension on girts for door openings are only needed on the hing side of doors with full and half surface hinges.
Bar extensions on girts for framed openings is only required for the sills.
Determine Americians With Disability (ADA) access requirements with the plant representative.
Determine building code classification with the building officials as early as possible before construction starts.
Determine building code requirments and insurance carrier requirements for fire wall and other rated areas.
Discuss with construction services who is responsible for sealing siding openings, especially in environmentally controlled rooms and rack rooms. Concrete block is not the best option.
Consider using a pile or caisson foundation system which does not require excessively deep excavations and allows construction work to be performed above grade.
Minimize the amount of excavation work and maintain a constant foundation depth throughout the project.
Design and schedule the project to minimize the amount of time excavations are open.
Keep detailed work above grade; simplify all below grade work.
Allow adequate clearance for shoring, forms, and workers within the excavation.
Minimize the amount of excavations required in backfilled or other loose soil, and where there are vibrations from railroads, highway traffic, or large machines.
Provide road access into large, deep excavations such as wastewater treatment ponds or bath tub shaped excavations.
Provide a seal slab or walls in excavations where the soil is saturated or likely to flood the excavation before backfilling.
When possible, avoid excavations below the water table.

When possible, avoid the use of sheet piling.
Comply with CAL OSHA shoring requirements of excavaton during foundation and underground utility designs. Try to avoid deep footings and trenches.
Consider specifing fabric or granular material or mud mats in the bottom of excavations.
Allow for the placement of underground utilities using trenchless technologies rather than the cut and cover method.
Avoid requiring trenches in previously backfilled or disturbed soil, or which cross between different types or conditions of soil.
Avoid designing utilities which cross under existing pipelines, run parallel to immediately adjacent existing pipelines, or intersect manhole excavations.
Design open drainage pipes for storm sewers to allow for easy access to and removal of debris.
Design sewer gratings such that the openings are not easily plugged by debris, but not too large that a worker's foot will go through.
Cover open drainage routes in high foot traffic areas to prevent tripping hazards.
Design all impoundments or holding ponds with emergency bypass capabilities.
Ensure that all accessways and manholes are provided with venting or non-venting lids appropriate to the service and traffic location.
Specify corrugated HPDE pipe for storm drains.
Ensure that all open sewer embankments are designed for adequate stability under anticipated worksite conditions.
Provide sewers with adequate accessways to allow for inspection and maintenance operations.
Ensure that sewer lines are suitable for the maximum temperature service conditions.
Provide adequate clearance between process/sanitary sewers and any adjacent or crossing potable water lines.
Design process/effluent sewer systems to vent any gases to the outside of all buildings or other project work areas.
Require the constructor to locate, or "pothole", existing underground utilities before excavation operations begin.
Require hand excavation when near existing underground utilities.

Design underground utiltiies (piping, ductwork, storm drains and etc) early enough so that they can be installed during the site work and foundation phase of the project.
Engineering representatives should coordinate the underground lines so they can be in common trenches and installed at the same time.
Consider making a composite drawing of all existing and proposed under ground utilities. This provide a good planning drawing and reduces the possibility of interferences.
Orient the project layout or grade the site accordingly to minimize the amount of work on steep slopes.
Maintain site distances on the project site and haul roads.
Limit long hauls on steep grades.
Prepare, or require the submittal of, an erosion control plan.
Consider providing a covering over walkways to protect them from cooling tower plume.
Design a minimum amount of slope into walkways to prevent puddling.
Project Engineer has communicated IHASCOMI project information required for design engineering personnel making site visits. (Each person that is sent to the job site must be informed of any potential hazards.)
A constructability meeting has been held with representatives from Plant, Construction Services, and Power Engineering to discuss safety-related items.
Underground hazards (electrical duct banks and cables, buried pipes, etc.) and reference drawings locating any potential hazards are identified.
Prohibit access near hoist and crane electrification components.
Applicable codes and standards have been reviewed for requirements impacting the design of a safe facility.
All potentially hazardous areas have been defined per Chapter 5 of the National Electrical Code. Hazardous areas have been identified and boundaries located.
Equipment and electrical devices located in hazardous areas meet requirements for area classification.
Provide electrical system enclosures which are adequate for the expected environmental and climate conditions.
Equipment is located for easy access and operation from floor level.
Do not locate electrical rooms under pipes carrying liquids.
Electrical equipment has been located to maintain proper safety and working maintenance clearances.
Access ways are clear of any electrical equipment that might cause ingress or egress obstruction. Position controls and control panels away from passageways and work areas.
Exit door for emergency egress are properly located in switchgear and high voltage rooms.

Emergency controls and displays are clearly identified. Provide safety switches, pull cords, alarms, etc. which are standardized, clearly displayed, and easily identifiable.
Ensure a disconnect means is provided for all sources of power supply to the equipment. For electrical power there must be an air gap between the line and/or equipment and all sources of power.
Warning devices (e.g., fire alarms, smoke alarms, sirens, etc.) are standardized and different systems are compatible with each other.
All electrical equipment, major mechanical equipment (i.e., pumps, valves, piping systems, etc.) and civil/structural components (i.e., columns, rebar, handrails, etc.) are properly grounded.
Cable tray systems are adequately and properly grounded.
Conduits that are used as ground paths are continuous and securely installed.
Equipment grounding circuits run to all motors, lighting fixtures, and transformers rated 480 volt or above.
Lightning protection is adequate for all buildings and structures.
Lightning protection conforms to the requirements of National Fire Protection Association (NFPA) Standard No. 780 and Southern Generation "Standard for the Design and Installation of Lightning Protection Systems for Generation Facilities".
Input from Civil Design has been obtained for raceway supports where necessary.
Fire stops have been included for all cable tray and conduit penetrations of fire-rated walls or floors.
Fire stops have been included for cable tray vertical risers at all floors.
Cable trays are marked to show the voltage level of the contained circuits (i.e., instrument, 120 volt control, 480 volt power, 4160 volt power, etc.).
Cable tray covers are specified at floor transitions and where cable is exposed to possible damage.
Encase new underground conduit duct banks in concrete which has been colored red on the top surface.
Require a red colored warning tape to be placed approximately 12 inches above direct buried power cables.
Proper color coding sequencing per the National Electrical Code is used for individual conductors of a cable (e.g., green ground and white or gray neutral).
Cables are tagged on each end with the proper identification.
Cable tags specified are permanent and easily readable.
Medium voltage armored cables are properly color coded.
Provide adequate illumination on projects during work at night.
Lighting is adequate to insure safe task performance by personnel. This includes general area lighting, instrument racks, pumps, valves, etc.

Compliance with Illuminating Engineering Society of North America (IESNA) guidelines.
Provide permanent electrical outlets on roofs to allow for future roof maintenance.
Phasing for lighting is mixed to avoid Istroboscopicl effect.
Adequate emergency lighting has been provided. This includes both exit lighting and emergency general area lighting.
Quartz or incandescent emergency lighting has been specified for lamp restrike ride through.
Design and schedule lighting systems to be erected with the structural framing.
Paging system will support emergency personnel notification requirements.
Emergency sirens or horns required for evacuation notification.
Warning placards, labels, and decals are properly positioned.
Warning signs are standardized throughout the project.
Equipment nameplates accurately represent electrical device identification and function.
Equipment nameplates are easily readable and properly positioned.
Electrical equipment is compliant with National Fire Protection Association (NFPA) Standard 70E requirements.
Protective relaying requirements have been reviewed and required settings installed in the equipment.
Grounding study and recommendation completed and used for completion of plant grounding drawings.
Equipment withstand and interrupt ratings are adequate to protect both equipment and personnel.
Minimum power cable sizes have been specified for both fault withstand and continuous power rating.
Station service load study performed to ensure that switchgear and buswork is adequate for the service.
Specify high solids, and no, or low, V.O.C. coating systems.
Design and schedule materials and equipment to be painted and/or insulated prior to erection or placement.
Mount the toprails on top of the posts, rather than on the side of the posts.
Provide a minimum clearance of 1-1/2 inches along the top and sides of the toprail.
Do not attach equipment or other objects to the toprails.

Connect railing members by welding rather than bolts.
Design joints and railing ends to be rounded and smooth.
Design handrails and the top rails of a stairrail system to withstand at least 200 lbs. applied within 2 in. of the top edge in any downward or outward direction, at any point along the top edge.
Provide continuous toeboards along the length of guardrails.
Use a uniform railing height throughout the project.
When the top edge of a stairrail system also serves as a handrail, the height of the top edge should be between 36 and 37 in. from the upper surface of the stairrail to the surface of the stair.
Design the height of handrails to be between 30 and 37 inches from the upper surface of the handrail to the surface of the tread.
Design intermediate vertical members on stairrails and guardrails to be at most 19 inches apart.
Provide permanent guardrails around floor openings.
Provide permanent guardrails around roof openings.
Design and schedule handrails, guardrails, and stairrails to be erected as part of the structural steel erection.
Provide a guardrail around roof accesses and roof work areas.
Position equipment controls and control panels away from passageways and work areas.
Indicate on the contract drawings the location of equipment shut-off valves and switches for existing utilities. Allow the constructor access to these locations for emergency situations.

Place electrical circuit breaker boxes in sight of the equipment which they affect.
Provide clearly marked and identified emergency controls and displays.
Allow adequate access to equipment controls for ease of operation.
Ensure that all equipment is grounded and protected against lightning.
Isolate all live conductors and equipment from accidental contact.
Ensure an adequate interrupting rating to protect all equipment.
Ensure that all electrical equipment is adequately cooled and ventilated.
Minimize the amount of overhead work.
Locate underground equipment in an area easily accessible for excavation. Allow sufficient area around the excavation for stockpiling the soil.
Locate rooftop mechanical/HVAC equipment away from the structure's edge and skylights.
Ensure that equipment located in a hazardous area meets the requirements for the area's hazard classification.
Design all mechanical equipment and HVAC components to meet the anticipated material, corrosion, and loading requirements of the construction site.
Design overhead equipment and their supports to hold up the weight of a construction worker.
Specify the material hoist or crane loading capacity to be clearly stenciled onto the hoist or crane beams or rails.
Provide purging cycles and special interlocks for all gas- and oil-fired equipment.
Ensure that the shut-off head on all pumps is compatible with the associated piping.

Design piping systems which feed tanks, chests, and large walk-in type equipment to prevent inadvertent system activation. (LO/TO procedures)
Ensure that safety relief valves exhaust and drain away from passageways and work areas.
Locate valves such that they can be operated easily, or so that a standard type of operating device can be installed. Consider using remote valve operators.
Provide remotely operated valves or valves with extension handles when valves are located near hazardous materials or in confined spaces.
Provide a safety valve on the discharge of positive displacement type air compressors and multi-stage centrifugal compressors to avoid over-pressurization in case the discharge valve is closed.
Provide relief valves for heat exchangers and chiller refrigerant.
Design ventilating and lighting fixtures in a mechanical room and confined space to be operated by the same switch.
Provide ventilation systems in mechanical rooms and confined spaces which are temperature, oxygen depletion, or refrigerant controlled.
Design and schedule ventilation and illumination in stair shafts to be operable during construction.
Provide ventilation systems around fueled equipment operating indoors.
Do not locate mechanical equipment in or directly adjacent to passageways.
Provide a clear, unobstructed, spacious area around all permanent equipment. See Section 1926.403 of the Code of Federal Regulations for working clearances.
Ensure that all equipment enclosures meet hazardous location classification requirements.
Do not place machinery breathing equipment, oxygen sensor, refrigerant sensor, or refrigerant/fuel burning equipment in the same space unless a clean air source is provided.
Keep the finished floor around mechanical and HVAC equipment free of steps, blockouts, etc.
Place all equipment and related hardware on an elevated housekeeping pad above the finished floor level.

Locate lifting eyes, hoist, or crane above equipment to aid in the installation and maintenance of the equipment.
Minimize the number of wires, cables, and hoses laid on walking surfaces. Use elevated cable trays or hose supports.
Specify mechanical and HVAC equipment which does not produce high noise levels while operating. See Section 1926.52 of the Code of Federal Regulations for acceptable noise levels.
Provide guards around equipment to protect workers from moving parts.
Provide guards around fan inlets/outlets and exhaust ports.
Provide signs, lights, alarms, etc. as necessary to ensure safety near exposed equipment.
Provide smoke detectors or insulation around equipment susceptible to fire.
Design and schedule new air conditioning and ventilating systems to be in use as early as possible in the construction phase.
Minimize the need for special or complicated equipment installation operations.
Design and schedule equipment to be painted and/or insulated prior to erection or installation.
Schedule new ventilating systems to be in use in areas in which painting or other coatings will be applied, prior to their application.
Design and schedule safe tie-ins to existing utilities.
Require systems, components, and welds to be tested to ensure they meet minimum requirements. Types of testing to consider: hydrostatic, radiographic, ultrasonic, magnaflux, weld sectioning, dye penetrant, halogen mass spectrometer, etc.
Design for safety against possible equipment failures, such as desuperheated, control valve, or component failure.

A bypass around a reducing valve should not have greater capacity than the reducing valve unless the piping is adequately protected by relief valves or meets the requirements of the higher pressure system.
Provide proper protection to prevent injury or damage caused by escaping fluid from relief or safety valves if vented to the atmosphere.
Prevent "water hammer" by providing air vents, surge valves, surge chambers, or delayed or timed valve operation.
Position controls away from passageways and work areas.
Locate valve controls so that handles can be reached easily, or so that a standard type operating device can be installed.
Indicate on the contract drawings the location of shut-off valves and switches for existing systems. Allow and provide access by the constructor to the locations.
Ensure that control valve specifications meet the piping specifications for body rating, body material (corrosion and hazardous services), and flange type.
Size control valves with consideration of noise level.
Provide a tag or other positive i.d. of the appropriate pressure, temperature, etc. on all valves.
Direct safety relief valve exhausts away from passageways and work areas.
Consider rupture disks as a safety device either in conjunction with or as a substitute for safety valves, or to act as an explosion door on vessels and piping subject to explosions.
Check safety relief valves against the piping process to determine if the valves are required to be A.S.M.E. code stamped.
Provide relief valves between each pair of sectionalizing valves on lines containing liquids and subject to being both isolated and heated, such as heat exchangers, liquefied gas piping, etc.
Use a globe or throttle valve on a bypass.
Design covers over sumps and drains to be flush with the floor level.
Design area drains to be trapped or valved shut to avoid the spread of fire in case of a ruptured pipe.
Route piping drains and overflows to trench drains so that floors remain dry.
Pipe pump seal water in a manner to avoid slipping, e.g. case drains/base plates to hubs.
Design piping which carries hazardous fluids to have a double lock-nut capability. Allow for a pressure bleed on trapped hazardous fluids, especially steam and condensate bypasses.
Eliminate drainage of slippery and dangerous chemicals into passageways and work areas.

Avoid routing dangerous fluids over equipment, control boards, aisles, and operator areas to avoid injury in case of a pipe leak.
Check that foreign piping components are compatible with other piping system components.
Color code the pipes to easily identify their contents.
Show the pipe content flow direction on the contract drawings so that the first valve upstream of an emergency can be easily located.
Avoid interior welds in large pipes and tanks, and ensure that welding conditions are appropriate for the type of pipe material, e.g. alloy piping systems requiring PWHT/preheat.
Specify the use of hose racks for all areas requiring hoses.
Design piping system components to meet all national, state, and local building code requirements.
Do not make direct cross connections between drinking water or utility systems and plant or process streams.
Design trap discharge piping for the pressure of the piping system being trapped unless protected by vents or relief valves.
Minimize pockets in piping systems. Trap all pockets.
Minimize flanges in piping under high pressure, or which contains explosive or lethal gases.
Provide adequate safety measures in the event of possible equipment failure.
Design adequate protection against over-pressure for all piping components.
Locate explosive or lethal gas lines outside of buildings, or in areas properly ventilated. Use all-welded construction to reduce chances of a leak.
Design all impoundments for liquids to provide a means or facility to accommodate emergency bypass conditions.
Design pipe materials to be chemically resistant to the fluids the system is designed to carry.
Route piping lines below electrical/instrumentation cable trays to prevent the chance of electrical shock due to leaking pipes.
Minimize the amount of overhead work.

Locate piping lines which are under very high pressure or contain explosive or lethal gases on the outside of buildings or in areas properly ventilated and guarded.
Do not locate piping in rooms containing high voltage equipment, bare wires, or bus bars.
Route piping to avoid "head knockers" (6'-6" min. above grade) and tripping hazards.
Provide fall restraint cables along the length of overhead piping runs.
Design overhead piping and supports to hold up a worker.
Provide for thermal expansion of the piping by adding pipe bends, offsets, etc.
Design steam lines with drips or freeblows to prevent "steam hammer" or "slugging".
Design cross connections between low and high pressure systems with one or more of the following valves: double valves (both to have high pressure rating), high pressure check valve, normally open vent valve between double valves, or a relief valve on lo
Design and schedule piping materials to be painted and/or insulated prior to erection or installation.
Design large pipe sections to be oval or have one flatten portion to prevent rolling.
Design in connection points on piping sections for lifting operations. Consider designing the connection points such that after pipe installation they can be used to connect the pipe sections.
Design and schedule safe tie-ins to existing utilities. Ensure that the tie-in is appropriate for the piping contents and system. (stopple/hot top/cold cut, rubber plug and weld flange/unbolt)
Use bolted rather than welded connections when working around existing flammable structures.
Minimize the need for "hot work" permits by providing adequate buffer from existing piping systems.
For taller buildings, design and schedule the fire water system to be installed early in the construction phase.

Design and schedule an underground fire water system to be constructed throughout the project site before construction begins.
Minimize downtime periods of existing automatic sprinkler systems.
Require performance testing of the piping system, components, and welds using such tests as hydrostatic, radiographic, ultrasonic, magnaflux, weld sectioning, dye penetrant, etc.
Require a stress analysis to be performed on applicable systems.
Ensure that the shut-off head on all pumps is consistent with the associated piping.
Design piping systems which feed tanks, chests, and large walk-in type equipment to prevent inadvertent system activation.
Locate underground lines in areas easily accessible for excavation. Allow sufficient area around the excavations for stockpiling and transporting the soil.
When new piping lines are to be placed below existing concrete surfaces, roads, or other traffic areas, design the lines so that they may be placed using trenchless technologies.
Note on the contract drawings the level of certainty and source of information on the location and size of existing underground lines.
On the contract drawings, mark a clear zone around existing underground lines.
Require hand excavation when near existing underground utilities.
Protect underground lines from crushing by use of sleeves or slabs, or by providing guard posts to prevent travel over them.
Provide over-sized pipe sleeves around lines under railroad tracks and highways to avoid damage to the tracks or roadbed in case of a leak.
Encase new underground lines in red concrete.
Require a brightly colored warning tape to be placed along underground lines approximately 12 inches above the lines.
Provide anchors or tie-downs for piping with push-type joints or other mechanical joints.
Provide the constructor with floor and roof design loads for use in determining material stockpile locations and heavy equipment maneuverability.
Provide adequate passageways and access areas around all equipment in control, electrical, and electronic rooms.

Locate electrical circuit breaker boxes in sight of the equipment it affects.
Do not locate electrical rooms under pipes carrying liquids.
Allow for at least two formal, controlled intersections at access points to the site.
Orient the project to allow for the construction of temporary roads, fire lanes, and approach roads during construction.
To minimize the risk of falling, minimize the number of offsets, and make the offsets a consistent size and as large as possible.
Ensure that the building height and area per floor meet all local building code requirements for the type of construction used.
Group floor openings together to create one larger opening rather than many smaller openings.
Locate floor openings away from passageways, work areas, and the structure perimeter.
Ensure that specified materials of construction are appropriate for the flammability hazards which may be encountered on the work site.
Do not specify materials which contain asbestos or other known hazardous substances.
Ensure that all materials meet the expected environmental and work site conditions.
Provide a clear, unobstructed, spacious work area around all permanent mechanical equipment. See Section 1926.403 of the Code of Federal Regulations.
Do not locate permanent mechanical equipment in or directly adjacent to passageways.

Position control valves and panels away from passageways and work areas.
Prevent access near hoist or crane electrification points and travel clearances.
Ball Mill structure has an overhead crane. This type area is new to plant employees. Consider all hazards associated with this new bridge crane.
Maintain a minimum clearance between the project and overhead power lines as outlined in Section 1926.950 of the Code of Federal Regulations.
Disconnect the power lines before construction begins.
Bury overhead power lines below grade before construction begins.
Re-route the power lines around the project site before construction begins.
Clearly mark the power lines with warning flags, tape, paint, chalk, etc., and note their location on the contract drawings.
Isolate from adjoining areas the storage areas for combustible and toxic materials, such as resins, paper, explosives, petroleum, plastics, etc.
Provide at least two means of egress on large maintenance platforms or walkways.

Minimize the number of confined spaces. Design access points to confined spaces as large as possible. Provide at least two access points to confined spaces.
Provide access by means of a ladder or stairway when there is a change in elevation of greater than 19 inches.
Establish survey control "permanantly" so that when structures are erected, survey control monuments are still accessible.
FGD General arrangement will provide enough space to lay the crane boom down during periods of high winds
Locate exterior stairs and ramps on the sheltered side of the structure to protect them from rain, snow, and ice.
Locate exterior stairs and ramps away from the north side of the structure to minimize the buildup of moss and ice.
Design stairs and ramps to run parallel and immediately adjacent to the structure, rather than perpendicular to the structure.
Do not locate constructor material lay-down areas next to or under electrical power lines.
Allow adequate room for constructor parking, temporary buildings, shops, material storage areas, and unobstructed access to and from the project site.
On sloped sites, orient the project layout or grade the site accordingly to minimize the amount of work on steep slopes.
Allow for pedestrian traffic to be isolated from construction vehicular traffic.
Allow adequate clearance for shoring, forms, equipment, and workers to perform below-grade work.
Locate new underground utilities and other below-grade features in areas easily accessible for excavation. Allow sufficient area around excavations for stockpiling the soil.
Avoid locating new utilities which cross under other pipelines, run directly adjacent to existing pipelines, intersect previously backfilled, disturbed, or fissured soil, intersect manhole excavations, or cross different types or conditions of soil.

Consider area drainage of excavations during construction when developing the plot plan.
Locate roof openings away from the edge of the structure.
Group roof openings together to create one larger opening rather than many smaller openings.
Eliminate tripping hazards around roof openings.
Locate rooftop mechanical/HVAC equipment away from roof openings.
In embankments directly adjacent to the road edge, provide an initial bench at the road grade to provide room for crews to work.
Provide structural support at the edge of roadways to keep heavy construction equipment from crushing the edge and overturning.
Provide a smooth transition between the road and shoulder.
Design the slope, width, height, turning radius, and surface treatment of traffic surfaces with consideration of the anticipated size, weight, and maneuverability of the construction equipment.
Design traffic barriers and guardrails so that there is no need to temporarily or permanently replace or re-design them when new pavement overlays are put down.
Locate project control points away from areas of high construction.
Guard posts are required to protect steel bents and structures from trucks or loaders in vehicle access areas.
Guard posts are required to protect equipment adjacent to vehicle access areas.
Require hand excavation around existing underground utilities.
Design new utilities under roadways and sidewalks to be placed using trenchless technologies or tunneling instead of trenching.
Design and schedule new parking areas to be constructed as early as possible to provide a formal, safe location for workers to store materials and equipment.
Prior to the start of the project, erect informational signs near the project.

Use a slope of 1/8" per foot minimum to prevent water ponding.
Design ladders to be vertical, or not exceeding 15 degrees forward, and straight throughout their length.
Orient ladders such that the person faces the structure while climbing.
Provide safety gates at the top of walk through and side access ladders.
Provide a minimum 2'-6" x 2'-6" landing area at the top and bottom of ladders. Coordinate the layout of the landings with the structure design to eliminate tripping hazards.
Design the step-across distance between the center of the step/rung and the nearest edge of a landing to be between 7 and 12 inches. Provide a landing platform if more than 12 inches.
For walk-through-ladder extensions, omit steps/rungs within the extension. Provide between 24 and 30 inches clearance between the side rails.
Design the side rails and rungs of step-through ladders to extend at least 42 inches above the floor or landing platform. Side-access ladders rails and rungs shall extend 4'-0" above the floor or platform.
Design ladder steps/rungs to be spaced between 11 and 12 inches apart, parallel, level, and uniformly spaced throughout the ladder.
Locate the first step/rung between 6 and 12 inches above the bottom landing, and the top step/rung at the level of the top landing.
Design the ladder steps/rungs of individual step/rung ladders to be shaped to prevent slipping off the end of the steps/rungs.
Design horizontal bands to be fastened to the side rails of rail ladders, or directly to the structure for individual-rung ladders.
Design vertical bars to be on the inside of the horizontal bands and fastened to them.
Design horizontal bands to be spaced at intervals not more than 4 ft. apart between centerlines.
Design vertical bars to be spaced at intervals not more than 9.5 in. apart between centerlines.
Keep the inside of the cage clear of projections.

Design cages to extend at least 27 inches, but not more than 30 inches, from the centerline of the step or rung, and not less than 27 inches wide.
Design the bottom of the cage to be between 7 and 8 feet above the point of access to the bottom of the ladder. Flare the bottom of the cage not less than 4 inches between the bottom horizontal band and the next higher band.
Design the top edge of the step-through cage ladder to be a minimum of 42 inches above the top of the platform, or the point of access at the top of the ladder. Design the top edge of the side access ladder cage to be a minimum of 48' above the top of th
Provide ladder cages, wells, or other safety devices where the length of climb is less than 30 feet but the top of the ladder is at a distance greater than 30 feet above lower levels.
If the total length of a climb equals or exceeds 20 feet, provide a cage or well, and multiple ladder sections, each section not to exceed 30 feet. Offset each ladder section from adjacent sections, and provide landing platforms at intervals of 30 feet m
Design ladders to prevent injury from punctures or lacerations, and prevent snagging of clothing.
Provide a minimum perpendicular clearance of 7 inches between ladder rungs, cleats, or steps, and any obstruction behind the ladder, except that the clearance for elevator pit ladders may be no less than 4.5 inches.
Provide a minimum perpendicular clearance of 30 inches between the centerline of ladder rungs, cleats, or steps, and any obstruction on the climbing side of the ladder. If obstructions are unavoidable, clearance may be reduced to 24 inches provided a def
Design ladders to be capable of supporting at least two loads of 200 lbs. each concentrated between any two consecutive attachments.
Design each step or rung to be capable of supporting a load of at least 200 lbs. applied in the middle of the step or rung.
Design ladders for any anticipated loads caused by ice buildup, wind, rigging, and impact loads resulting from the use of ladder safety devices.
Consider stairs in lieu of a ladder when the ladder will be used frequently to move material and equipment.
Provide a non-slip surface treatment on ramps to help prevent slipping.
Provide cleats on steel or wood ramps, or create grooves on concrete ramps, to help prevent slipping.
In areas which receive snow, provide a covering, overhang, or extend the roof line over exterior ramps.

Use a maximum ramp slope of 7 degrees.
Maintain a uniform stair slope throughout the project.
Use consistent tread and riser dimensions that meet code requirements throughout the stairway run and the project.
Establish survey control "permanently" so that when structures are erected, survey control monuments are still accessible.
Coordinate the layout of exterior stair landings with the foundation design to provide a smooth, clear landing area free of tripping hazards.
Avoid stair landings constructed separate from the stairs.
Provide a minimum 2'-6" x 2'-6" landing area.
Build stair landings up above an uneven grade.
Use perforated steel or steel grating for stair treads on exterior stairways to prevent slipping, or when there is a need to "see through" the stairs in tight, congested work areas.
Consider using prefabricated or ground-assembled stairways which can be erected as one assembly.
Use steel or concrete for stairways in areas where welding or other potential fire sources are present.
Use concrete or other nonconductive materials instead of steel for stairways in areas where electrical work will be performed.
Design exterior stairs to be directly adjacent and parallel, rather than perpendicular, to the structure.
Design circumferential stairways to ascend clockwise.
Place exterior stairs on the sunny side of the structure to prevent the buildup of ice.

Provide at least one handrail or railing along stairways with 4 or more risers, or which rise more than 30 inches in height, whichever is less.
Design and schedule permanent stairways to be built as soon as possible in the construction phase and used by the construction workers.
Steel member marking and tagging procedure should be described in our purchase order documents. This can become complicated for hot dipped galvanized projects. See what construction services representive wants for the marking and tagging.
Consider the erection process when designing steel connections.
Design beam-to-column double-connections to have full support for the beams during the connection process.
Design a fix for steel beams of common depth connecting into the column web at the same location.
Provide pin-hole or bolted connections on beams and columns to create proper alignment and stability immediately after placement of the members.
Erection drawing, bolt list, and fasteners must be delivered prior to/or with the delivery of the fabricated steel.
Discuss with construction services representatives the need to provide holes in the webs of beams above piping for attachment of supports and lifelines.
Design roof to support construction equipment and scaffolding used to install insulation and siding.
Use steel pre-fabricated or ground-assembled members for work over diked areas, water, railways, roads, etc.
Spec for Structural Joints Using ASTM A325 Bolts (pretensioned) requires at least 3 bolts of each diameter, length and grade (along with flat hardened washer and nut) to be checked at the job site in a device capable of indicating bolt tension. Structura
Discuss with construction services representative if our engineers needs to design a method of attaching temporary railing and safety lines for construction workers.
Consider using composite beams to support elevated concrete floors.

If the utility bridge steel is needed early consider a typical bay spacing, bent design, and bridge or truss design. Consider framing trussed into column flanges.
Discuss with construction services representatives if the structural drawings, shop fabrication drawings, and fabricated steel, should make provisions for attaching field safety appurtenaces. Example: Utility bridge and truss make want to have holes for
Maximize the use of field bolted joints (instead of field welded joints) to expedite erection.
Identify shop assembled items. Consider using modular shop welded frames and platform sections to reduce erection time.
(For unit price steel fabrication contracts) Determine the fabricator's commitment to deliver steel. Is the fabircator: flexible to shift the steel deliver schedule; increase the scope of work; decrease the scope of work; sublet work; or work overtime.
Consider who furnishes concrete metal form deck placing drawings, deck, closure pieces, and fasteners. Who install these items.
If concrete edge form deck is used, determine: who provides and install; if welded or bolted; if ground assembled or in the air; and if plate will be held 2' short to allow the iron worker to bolt up the beam to column connection.
Determine is MTO, material take-off, pay categories will be shown on the steel shop drawings.
Design pipe bridges to maintain adequate clearances for construction equipment and cranes.
The steel inquiry documents should consider these items: tolerances, need for fabricator's representative in the field; basis for change order, shipping weights (with out material waste), touch up paint, erector should verify top of piers and anchor bolt
Steel drawings and specifications allow or encourage ground assembly of utility bridges, flue duct bents and towers. For example, the utility bridge 60-foot trusses could be ground assembled. Then the pipe and cable tray members could be added before th
The flue gas duct work and/or duct support steel will be designed for construction loads associated with the installation of walk boards and support brackets for construction workers.
Limit the lift heights of steel erection.

Ask construction services representive if columns should be provided with holes at 21 and 42 inches above the floor level to provide support locations for lifelines and guardrails. Consider impact of column splice on these holes.
Locate column splices between 2 and 4 feet above the finished floor level, and at two-story intervals. See the Technical Lead - Structural Steel for recommended column splice locations and maximun lenghts of columns.
All columns shall be anchored by a minimum of 4 anchor rods (anchor bolts).
Anchor bolts shall not be repaired, replaced, or field-modified without approval of the structural engineer of record.
In multi-story structures, when holes in the column web are used for perimeter safety cables, the column splice must be placed sufficiently high so as not to interfere with any attachments to the column necessary for the column splice.
Decide who will provide shims below base plates. Decide if shim will be left in place after the grout in installed.
Decide which base plate will be shipped loose and which will be shop welded.
Try to minimize the horizontal struts and vertical bracing in areas where construction and operation personnel will need access.
Structural steel fabrication and erection shall meet the requirement of Code of Standard Practice of Steel Buildings and Bridges March 7, 2000.
Bolts should have the same diameter, finish, tension requirements, washer, same ASTM designation, connection type (N or X threads in shear plane), and installation method.
Consider using a "Squirter DTI" (Direct Tension Indicators) if pretensioned high-strength bolts are a requirement.
Design the structural members to withstand all anticipated construction loading during fabrication, storage, erection, and final connection.
Design member depths to allow adequate head room clearance around stairs, platforms, valves, and all areas of egress.

Minimize the amount of overhead work.
Design members which are of consistent size, light weight, and easy to handle.
Limit lift heights for steel columns.
Design connections to be bolted or welded in the shop rather than in the field.
Minimize field welding of steel with a galvanized coating.
Ensure that the welding procedures specified are compatible with the materials being welded.
Roof steel shall be designed for fall protection anchorage points.
Drawings and specifications for steel should meet the current codes and standards.
Engineer's stamp is required on all engineering drawings and specifications generated by outside companies.

Design, fabrication, and erection of steel shall meet the requirements noted in "OSHA STEEL ERECTION STANDARD (SUBPART R)".
Discuss with construction service representatives any OSHA 1926 Subpart R requirements that needs to be included in our steel technical specifications.
Permanent stairs with handrail, railing, stringers, grating, and treads must be designed, purchased, and installled to coinicde wiht the building steel.
Railing must be designed, purchased , and installed to coincide with the installation of the building steel. Temporary safety railing cable will be installed in those areas which will have siding or equipment.
Sumps will have steel ladder rungs for access. Steel grating and support steel will be furnished as required to support the pumps and grating. Sumps will be elevated 18-24 inches to keep vehicles off the top of the sump
Grating with pre-cut openings should have temporary plywood covers ties over them, using proper gage wire, until the openings can be secured with handrails, hatches, etc. Install the plywood covers in the shop or on the ground at the plant construction s
Consider adding 1926 Subpart R Appendix D (1926.760) to the code requirements listed in the steel erection inquiry. Appendix D - Illustration of the Use of Control Lines to Demarcate Controlled Decking Zones (CDZ).
CDZ Requirement: The controlled decking zone (CDZ) is defined by a control line or by any other means that restricts access
CDZ Requirement: A control line for a CDZ is erected not less that 6 feet (1.8 m) nor more than 90 feet (27.4 m) from the leading edge.
CDZ Requirement: Control Lines extend along the entire length of the unprotected or leading edge and are approximately parallel to the unprotected or leading edge.
CDZ Requirement: Control lines are connecteed on each side to a guardrail system, wall, stanchion or other suitable anchorage.
CDZ Requirement: Control lines consist of ropes, wires, tapes, or equivalent materials, and supporting stanchions.

CDZ Requirement: Each line is rigged and supported in such a way that its lowest point (including sag) is not less than 39 inches (1.0 m) from the walking/working surface and its highest point is not more than 45 inches (1.3 m) from the walking/working su
CDZ Requirement: Each line has a minimum breaking strength of 200 pounds (90.8 kg)
Ball mill roof decking requirements will meet requirements noted in OSHA Steel Erection Standard (Subpart R). Workers will be able to tie support life lines. Some roof steel is designed for fall protection anchor loads.
Provide a non-slip walking surface on walkways and platforms exposed to the weather.
Provide multiple means of access to elevated walkways and platforms which can be used during emergency situations.
Use serrated grating, instead of checkered steel plate, for walking surfaces to prevent slipping hazards.
Design access platform large enough to install a 4'x4' scaffolding so that the expansion joints can be installed and replaced
We are pllanning to use steel beams, grating, and railing to access the slurry talkn agitator. Agitator platform will be 4' wide.
Stair riser will be 7" maximum. Stair treads will be 11" minimum.
Provide design documents for location of temporary bracing and a written procedure for the order of installation of modification material to preserve the correct geometry and structural integrity of the existing ductwork during demolition and modification
When connection new stiffener framing to existing stiffener framing, design the connection to provide maximum flexibility in fit-up and welding for ease of installation.
When a portion of the existing duct will be preserved and a new piece of ductwork will tie-in, the tie-in point should be an easily reinforced point, preferably at an existing stiffener, binder or truss.
Engineering will provide a drawing showing hte duct cut line and a duct removal and damper installation sequence.
Provide a procedure to thoroughly inspect the ductwork both inside and outside, paying close attention to skin plate thickness, external stiffener web and flange thickness, external stiffener connections, internal pipe bracing wall thickness and internal
Provide details for removal/replacement of internal pipe bracing and modification/strengthening of pipe bracing connections.
Provide details for replacing/patching thin portions of the ductwork skin plate.

Provide details for modification /strengthening external stiffener connections.
Provide details for adding new or strengthening external stiffeners.
Provide a detailed procedure for systematic removal/replacement of modification/strengthening.
Consider the economy of duct replacement vs preservation and strengthening.
Utilize field bolts rather that field welding where possible since bolted connections can be correctly made by less highly trained personnel than welded connections.
Avoid hard mating surfaces since they require very close tolerance.
Where hard mating surfaces are required, consider using variable thickness shim packs to facilitate erection.
Where field connections are required, connections should be designed to allow use of temporary pins or support of the members until welding is complete.
All field connections should allow for reasonable access of construction personnel.
Flue gas ductwork will have continuous walkways along one side of horizontal duct runs. Man doors will be spaced at 200 feet on center. Several stair towers will provide access to the walkway outside the duct.
Flue gas steel duct fabricator shall test shop welds for leaks. This will be noted in the specifications or on the drawings. The flue gas duct erector shall test field welds for leaks.
The flue gas duct work and/or duct support steel will be designed for construction loads associated with the installation of walk boards and support brackets for construction workers.
Flue gas duct work insulation may be installed on the ground except items note in 3. We assume 1) The C-shaped duct fabricated pieces will be joined in the field on the ground, 2) 20-foot sections of duct will be joined on the ground or in the air, and 3
Trucking the 2 modules either bolted or welded and nested together on the truck
Specify tolerances on the duct sections
Specify back to back flanges with the field sealing them together with a continuous butt weld.
Stagger the bolts in the back to back channels to better pull each of the channel flanges together.
Specify MC channel shapes at the support frames.

Large quantities will need to place an order from the mill as early as possible.
Large quantities need to place an order from the mill as early as possible.
Some fabrications need to hire a third party vendor to provide any site assembly of panels.
Consider large oversize "C" sections at plants such as Wansley. These loads would be over 15'-0" wide and use two escorts. The cost of these shipments versus field assembly needs to be studied.
Consider purchase of 6'-0" wide plate and splice at intermediate stiffeners.
Consider bolting cross members across both "C" sections for shipping and handling.
Civil ductwork drawings should show the design pressure. This will make is easier for plant and engineeriing personnel to determine this design paramated in the future.
When barge access is available, consider shop assemble of larger duct modules.
Avoid interior welds in tanks. Provide ventilation in the tank if interior welds are required.
Provide vents and overflow or relief devices to avoid over-pressurization, and to avoid creating sufficient vacuum to cause the tank to collapse.
Provide dikes around storage tanks which contain hazardous substances. Use a slab rather than an HDPE liner for the leak detection (LD) system on the bottom of large storage tanks.
Provide traps or valves on process sewers and area drains to avoid the spread of fire in case of a ruptured tank.
Ensure that tanks and vessels meet all local, state, and federal design code requirements.
Fabricate tank roofs at grade and lift them into place as one assembly.
Complete interior welds on tank walls before erecting the roof.
Provide a guardrail along the perimeter of the tank roof.
Provide connection points for lifelines at the center of the tank roof.
Protect underground tanks and vessels against crushing by use of sleeves, concrete slabs, or by providing guard posts to prevent travel over them.
Locate permanent atmosphere testing devices and forced air ventilation equipment at entrances to tanks and vessels.
Provide connection points adjacent tank and vessel entrances for attachment of a lifeline or safety harness.
Provide at least two access ports for tanks and vessels to aid in access/egress and ventilation.

Provide for a door to be installed in floating roofs for large vessels. Design and schedule the door to be installed prior to erection of the roof.
Coordinate the layout of tank stair landings with the tank foundation design to prevent tripping hazards.
Design circumferential stairs around tanks to ascend clockwise.
Engineering should provide, or require the constructor to submit, directions for a construction sequence in complicated or unique designs.
Conduct constructability reviews early in the design phase. Include the constructor and maintenance personnel in the reviews.
Provide engineering documents and schedule an underground firewater system to be constructed at the beginning of the project.
Engineering should show requirements for permanent emergency exit and egress signs to be erected early in construction.
Release engineering documents timely so that fire walls and fire doors may be constructed or placed early in the construction phase.
Prior to the start of the project, erect informational signs near the project site announcing the construction work and schedule.
Discuss road drawing release dated with construction services representatives. Consider providing good access for the prime contractor, especially in wet weather.
Provide engineering documents and schedule permanent stairways to be constructed as soon as possible.
Provide engineering documents and schedule permanent railings to be shipped and erected along with the structural steel as one assembly.
Schedule the release of engineering drawings such that sufficient time is allowed for materials to be purchased, delivered, and installed.
Provide engineering documents to support permanent telephone lines to be installed early in the construction phase. Locate the lines in remote buildings, process areas, and on the site perimeter.
Provide the engineering documents to support the installation of the permanent electrical system.
Provide engineering documents to support the early installation of permanent lighting systems.
If existing electrical lines need to be in service during construction, consider the possibility of reducing the voltage or current before construction begins.
Provide engineering documents that are user-friendly to pre-fabricate building components in the shop or pre-assembled pieces on the ground and erect them as one assembly.

Provide engineering documents to allow exterior wall structure and/or finish to go up with the framework or soon thereafter.
Engineer should provide a construction sequence of removing and add structural steel and/or concrete framing for structures with major rework.
Engineering documents should provide a work sequence for safe tie-ins to existing utilities.
Schedule air conditioning, heating, and ventilating systems to be available for use by the constructor at close-in.
Design and schedule ventilating systems to be in place in areas where coatings will be applied prior to applying the coatings.
Engineering specifications should require shop painting of materials, piping, and equipment.
Specify concrete test results to be verified before removal of the forms and shoring.
Concrete specifications should reference ACI code requirements for removing concrete forms and shores.
Review code requirements to determine if your modification requires you to bring the structure up to current code.
Indicate on the contract drawings the locations where shoring of the existing structure is required during construction.
Review the condition and integrity of the existing structure and indicate any known hazards or deficiencies on the contract drawings.
When working on or near existing structures, consider using bolted, rather than welded, connections to minimize the fire hazard.
Engineering should consider requiring the constructor to locate and mark the existing reinforcing steel prior to cutting into existing reinforced concrete members.
Specify modification sequence if the reworks inpacts the stability of the structure.
Indicate on the contract drawings the locations of shut-off valves and switches for existing utilities. Provide the constructor with access to these locations.

Indicate on the contract drawings the locations of existing underground utilities and mark a clear zone around the utilities.
Include the name, address, and telephone number of local utility companies on the drawings.
Note on the drawings the source of information and level of certainty on the location of underground utilities.
Limit the spread of fire by designing fire walls, parapets, fire stops, deluge systems, etc.
The plant personnel and project team must all understand the scope of work for demolition.
Plan who will provide the demolition drawings.
Plan how demolition drawings and pictures can effectively show the required demoliton. Determine if a sequence of demolition is required to maintain a safe structure.
Engineering and Construction Services personnel show discuss and agree on the engineering and construction schedule.
Evaluate where removed material will be placed.
Determine if any hazardous materials, such as asbetos, are present.
Evaluate if there is any salvageable material.
Determine the impact of utilities and services in the area of demolition.
Ensure instrument/devices requiring special design (purging, etc) have been reviewed, evaluated and are in compliance with project codes and standards.
Ensure instrument/devices are identified, classified, and shown on the project drawings.
Ensure warning labels and signs are provided to address warning and hazardous information to prevent possible property damage or personal injury.
Ensure warning labels and signs comply with codes and standards and are properly positioned.
Ensure design is in compliance with project codes and standards. Ensure instrument design is in compliance with Quality Standard for Instrument Air ANSI/ISA-S7.0.01-2004 (IEC 61511-1 Mod). Ensure design for boiler drum level indicators are in compliance
Ensure instrument performance and accuracy shall fulfill process and unit performance requirements for the project.
Ensure that variations in instrument and control types, material, ranges, etc. are kept to a minimum. Tubing size and material should be kept to a standard to minimize confusion in identifying.

Ensure temperature elements are designed ungrounded. Temperature elements are preferably not be grounded at the point of measurement.
Ensure thermowells are provided with all thermo elements and are in compliance with project codes and standards. Ensure thermocouple terminals are bakelite construction.
Ensure thermowells are within the range of ASME PTC 19.3. Ensure thermowells are designed to prevent damage caused by vortex-induced vibration over the range of velocities to be encountered. Ensure thermowells are designed with nipple-union-nipple exten
Ensure instruments/devices are compatible with process parameters associated with the project. Ensure design of transmitters are within their calibration range. Eliminate special equipment calibration, if possible. No transmitter will be selected for u
Ensure instruments/devices are design for environmental conditions associated with the project. Level gauge glasses and site flow indicators shall not be used for ammonia services.
Ensure other design disciplines are informed concerning equipment loading. Equipment heat load for control building HVAC systems. Equipment electrical load for instrumentation and control systems. Equipment weight load for piping or structural supports
Ensure station service support is adequate and indicated on the project schedule. Determine control system requirements and schedule. Determine building is adequate for control systems. Determine power available. Determine HVAC available. Determine s
Ensure construction storage is adequate for instrumentation, control systems, etc. Determine storage will protect equipment from the weather and abuse.
Communicate constructability review needs early in the project to project management.
Ensure controls system communications are checked for compatibility.
Ensure design for accessibility for instrumentation and accessories is complete. Root valves within easy reach. Drain and blow-down valves within easy reach.
Design to minimize device locations within confined spaces.
Design connections to be assembled in the shop rather than the field if possible. Assist to assemble flow elements in piping before lifting to pipe racks.
Design instruments/devices for purging cycles or interlocked for hazardous areas.
Ensure design for disabilities requirements associated with the project are communicated and documented.
Ensure design redundancy is engineered to increase reliability and reduce failures. Determine redundancy in design to reduce equipment failures. Determine the common cause and common mode of failure. Dedicated process switches will not be used when red
Ensure a clear understanding of the plants process safety design requirements is communicated to design personnel. Ensure that the client understands the limitation of the project design and is fully aware of these limitations.

Ensure instrument/devices are designed to be compatible with fluid and are in compliance with codes and standards. Ensure instrument/device material (gaskets, diaphragms, o-rings, etc) that comes in contact with hazardous, corrosive or contaminated fluid
Ensure the existing equipment and control systems are compatible with the project design codes and standards.
Ensure drawing delivery schedules are reviewed to provide documentation to construction in a timely manner. Ensure construction sequences have been reviewed to support document receipt.
Ensure procurement schedule have been reviewed to support equipment delivery. Ensure construction sequence have been reviewed to provide adequate storage of instrument and control equipment delivery.
Ensure construction schedule have been reviewed to support check-out, start-up and commissioning assistance by instrument & controls engineering personnel.
Ensure all control systems requiring communication with Plant Operating Information System (OIS) are in compliance with standards.
Ensure the Present Standards and Guidelines for GENGuard has been implemented. Objective of the GENGuard Program is to: (1) Raising awareness of risks associated with security issues. (2) Establishing and implementing Standards and Guidelines. (3) Est
Ensure design is in compliance with project codes, standards, procedures, and guidelines. Ensure Fossil Fuel Power Plant Human-Machine Interface: Task Analysis ISA-RP77.60.05-2001 has been reviewed. Ensure Fossil Fuel Power Plant Human-Machine Interface
Ensure controls are in compliance with Boiler and Combustion Systems Hazards Code NFPA 85.
Ensure Logic is designed and reviewed in accordance with project parameters.
Ensure components in system, which are paired to back up each other, will have a standby mode imposed upon the protective interlock scheme.
Ensure workstations are in compliance with project codes and standards.
Ensure controls software (configuration, graphics, etc.) are backed up regularly with two (2) copies (one backup on site and the other backup off site).
Ensure repetitive motion activities of operators are avoided, if at all possible.
Ensure controls are in compliance with ISafety Instrumented Systems and have been reviewed in accordance with ANSI/ISA-S84-00-01-2004 (IEC 61511-1 Mod). Ensure a checklist has been designed for Safety Instrumented Systems. Ensure adequate support is ava
As soon as possible, ensure time and dates are included in the engineering and construction schedule for engineering field support.
Ensure adequate access to controls equipment for ease of operation.
Ensure purging, equipment cycles and special interlocks are reviewed and simulated.

Ensure motors and associated equipment are designed for safe operation within the project parameters. Motor are prevented from being started if the starting permissives required for safe operation are not satisfied. Motors will automatically stop under
Ensure cable, wire, and accessories are in accordance with the "Cable and Cable Bus Standard for Fossil/Hydro Projects"
Ensure PVC insulated wiring is not in project design.
Ensure tubing is not routed in the same tray as electrical wiring and cable.
Ensure electrical connections on instruments/devices are from the bottom or side of the device.
Ensure power and controls wiring and cables are separated and not routed within the same tray.
Ensure fiber optic cables are design for reliability and safety.
Ensure a disconnect means is provided for all sources of power supply to the equipment. For electrical power there must be an air gap between the line and/or equipment and all sources of power. The clearance shall be verified in that the equipment has b
Design instruments & controls devices within the piping and support assembly design.
Design flow meter runs and other major equipment to be assembled before lifting.
Ensure enclosures are adequate for the expected environmental and climate conditions.
Ensure enclosures are supplied with adequate heater and ventilation.
Ensure the design and schedule for safe tie-ins to existing utilities have been reviewed and documented. Ensure the design for tie-ins have been reviewed to correspond with the construction schedule. Ensure adequate resources are available for the tie-i
Ensure existing equipment will comply with project codes and standards and is documented.
Ensure the existing equipment and control systems are compatible with the project design.
Ensure design for tie-ins will require a minimum of IHot Work PermitsI.
Ensure the location of shut-off valves, disconnects and other safety devices are identified and shown on the project drawings. Ensure construction will be allowed to access these locations for emergency situations.
Ensure the name, position, telephone and other necessary information is maintained in the project of individual contacts for existing tie-ins and/or equipment information.
Ensure equipment electrical cables, wiring and conduit are routed to avoid potential fire hazards.
Ensure instruments/devices are not located as to obstruct exists.
Ensure equipment requiring freeze protection have been identified and shown on the project drawings. Ensure items are indicated on the piping & instrument diagrams. Ensure electrical department are aware of power requirements.
Ensure equipment enclosures, panels, or cabinets contain adequate insulation, heaters, and controls to prevent damage to equipment from freezing.

Ensure the blow-down and shut-off valves are external to the equipment enclosures.
Ensure internal temperature indications are visible from the outside of freeze protection enclosures.
Ensure instrument ground connections are only at one point within the loop.
Ensure adequate information is available for installation of all instrumentation associated with the project.
Ensure instrument/devices are adequately protected from lightning damage and in compliance with codes and standards. Design for transient suppressers at transmitters. Identify ground sources and eliminate sensors.
Ensure the Standard for the Installation of Lightning Protections Systems NFPA-780 has been reviewed.
Ensure instruments/devices are accessible from grade, floors or platforms.
Ensure the location of the root valves and blow-down valves are visible and located accessible from grade, floors or platforms and valve discharges will be prevented from splashing or direct spray on the operator or equipment.
Ensure the equipment is located in an area away from possible leaking conditions. Ensure instrument/devices are not located under or near process lines that could leak and contaminate the equipment.
Ensure transmitters are located as close as possible to the process line connections. Locations of transmitters/devices are shown on the Instrument Location Drawings. Process line connections are shown on the piping isometrics and/or piping layout drawi
Ensure access ways are free from obstructions, tripping and interference hazards.
Ensure equipment is designed and located with a minimum requirement of pipe and accessories disassembly for maintenance and operation. Instrument arrangement shall allow for the removal of a sensor/detector head while maintaining the integrity of the oth
Ensure instruments/devices requiring visible indication are located in an illuminated area at a height and angle for adequate viewing.
Ensure instruments/devices are located in well ventilated areas.
Ensure adequate access to controls for ease of operation and maintenance.
Ensure instruments/devices meet the environmental, process and work site conditions.
Ensure instruments/devices meet the piping specification design issued for the project. All in-line elements that requires flanges shall follow the piping classification and specification.
Ensure instrument/devices are designed to be compatible with fluid and are in compliance with project codes and standards. Ensure instrument/device material (gaskets, diaphragms, o-rings, etc) that comes in contact with hazardous, corrosive or contaminat

Ensure instrument/device are not design to contain asbestos or other known hazardous substances.
Ensure root (shut-off) valves and instrument/device connections match and are adequate to meet the requirements for the project.
Ensure package suppliers have terminated instrument connections at the edge of the package edge in bulkhead connectors or junction boxes.
Ensure package suppliers design agrees and is in compliance with project codes and standards.
Ensure spacing between panels are in compliances with project codes and standards.
Ensure existing panels are adequate for project and meets the project codes and standards requirements.
Ensure that piping subject to thermal growth are compensated for.
Ensure expansion loops are designed for high temperature applications. Loop seal or siphon will protect steam pressure sensing devices that must be mounted above the process connections.
Ensure insulation and/or heat tracing have been provided in the design.
Ensure instrument connections and shutoff valves are accessible.
Ensure power requirements are communicated to the electrical design department.
Ensure thermowells are designed, calculated and specified for the process applications.
Ensure instruments/devices are within the design range listed on the mechanical equipment specifications.
Ensure instruments & controls documentation is provided for the project Process Hazard Analysis.
Ensure insulation and barriers are design into the system to provide personnel protection.
Ensure design will allow construction to maintain a neat, clean work area within the instruments & controls design area.
Ensure design personnel are trained for the project site and familiar with site procedures and requirements. Employees will be trained and will wear only company approved Personal Protective Equipment (PPE). Employees will wear eye protection that meets
Ensure proper location of warning signs to alert of hazards.
Ensure safety showers and eye wash stations are according to codes and standards. Safety showers and eye wash stations will be freeze protected and will incorporate alarms.
Ensure potential hazards are communicated to construction and contractors.
Ensure design personnel are familiar with site hazards associated with the project. Employees will be familiar with plant site hazard communication. Employees will be familiar with plant site toxic & hazardous substances. Employees will be familiar with
Ensure design personnel are familiar with plant site evaluation instructions.
Ensure instruments/devices requiring structural steel for mounting is designed to prevent any cutting, drilling, or bending of the structural steel.

Ensure instruments/devices requiring structural steel, equipment, or structural members for mounting and support of the instrument/devices does not require structural steel/members or equipment removal for frequent instrument/device maintenance.
Ensure instrument/devices mounted on structural steel are not subject to vibration or movement.
Ensure test equipment and tools needed to support equipment are specified for the project.
Ensure testing procedures are provided and in compliance with codes and standards.
Ensure equipment test reports are generated and filed in project file.
Ensure performance test connections are indicated on design documents and are accessible.
Ensure tubing material is adequate for the process temperature and pressure. For temperature exceeding 900 degrees F, ensure that 316H Stainless Steel tubing is specified. (Reference ASME B31.1).
Ensure all tubing complies with and is accordance with ANSI/ISA-S77.70, Fossil Fuel Power Plant Instrument Piping Installation. Ensure all tubing is specified, designed, ordered, and received with IMinimum Wall ThicknessI designation.
Ensure tube fitting for any steam services above 600 PSIG are designed for welded construction.
Ensure design of tubing, fittings, and tubing connections are minimized.
Ensure tubing subject to thermal growth are compensated for.
Ensure expansion loops are designed for high temperature applications.
Ensure insulation and/or heat tracing have been provided in the design.
Ensure tubing is not routed in the same tray as electrical wiring and cable.
Ensure foreign equipment have been reviewed for compatibility with connections, material, operation, and maintenance.
Ensure copper tubing is not allowed in ammonia services.
Ensure valve accessories (positioners, solenoid valves, position switches, etc) have been reviewed, evaluated, specified, and located to be accessible for the operation and maintenance of the control valve.
Ensure valve accessories are compatible with the control systems.
Ensure double valving for piping and tubing are met for any service above 600 PSIG.
Ensure that each pressure instrument with process connection shall have individual process isolation valves.
Require concrete test results to be verified before elevated form stripping and removal of shoring.
Specify the use of testing devices which are embedded in concrete members in order to test the strength of the concrete before form removal.

Specify testing procedures for complicated designs or specialized mechanical, electrical, or piping systems.
To prevent cave-ins due to vibration of loose soil, do not use driven piles in deep excavations in areas of loose or backfilled soil.
Avoid designing piles at angles flatter than 4:12 (horizontal:vertical).
Take heave into account when locating piles.
Each caisson rock socket needs to be inspected for competent rock soundness at the bottom
Use red dye concrete to encase underground utility duct runs.
When practical, design bottom of foundation to have the same elevation.
When developing a plot plan, group footings in a way that permits proper drainage of mass excavations.
Locate new footings away from existing foundations.
Some contractors may want to use 4" x 4" mat mesh or WWF on top of 12"spaced top rebar to provide a walking surface for the concrete workers.
Review clearances between forms, anchor bolts, sleeves, and rebar at congested pier locations to ensure that there is sufficient room for concrete placing and consolidating equipment.
Standardize anchor bolts to several different diameters, types and lengths.
When you review concrete mix, make sure the aggregate specified type and size reflects material the supplier intends to use.

When you review concrete mix, make sure the proper curing compound is specified for outside or enclosed conditions.
Before releasing concrete specification review mandatory requirements and optional requirements in ACI 301.
Equipment mounted on skids make the design and installation of the anchor bolts and foundation easier.
Where possible attempt to have rows of similar foundations (example: pumps or blowers) designed to have a single common raft foundation. This will reduce formwork, rebar, and construction manhours.
Approve or specify, in large foundations, the use of maximum size of aggregate to minimize the cement requirements and heat of hydration.
Standardize foundation sizes for pumps, piperacks, structures, and miscellaneous supports.
Extend foundations dimension 12" to allow setting wall forms on concrete slab.
Design foundations to be placed directly against earth, instead of forming, where soil, site and structural conditions permit.
Design small foundations and slab on grade without haunches.
Eliminate offsets, tapered sections, and other complicated shaped in foundations.
Consider using drilled adhesive or epoxy anchors or drilled mechanical anchors in foundations with small loads.
Consider using anchor bolt sleeve for equipment foundations.
Consider delivery time for hot dipped galvanized or alloy steel anchor bolts or anchor rods.
Provide adequate embedments in concrete foundations, piers and wall for future attachment of platforms, stairs, light fixtures, and etc.
Provide railing or grating on top of sumps.

Epoxy grout will not be used to grout equipment on scrubber project.
Sumps will have steel ladder rungs for access. Steel grating and support steel will be furnished as required to support the pumps and grating. Sumps will be elevated 18-24 inches to keep vehicles off the top of the sump
Sumps ,which contain a potentially corrosive liquid, should consider using a steel rung with protective plastic coating such as the "PS3-PFC" manhole steps by M.A. Industries of Peachtree City, GA. Consider adding a grab bar to enable the person to safel
Design and schedule the layout of stairway and ladder concrete landings to be constructed as part of the structure's foundation system.
Design and schedule slabs-on-grade, sidewalks, roadways, and other flatwork around elevated structures to be constructed as early as possible and available for use by construction workers.
Design the finished floor around mechanical equipment to be at one level (no steps, blockouts, slab depressions, etc.).
Keep steps, curbs, blockouts, slab depressions, and other tripping hazards away from window openings, exterior edges, and floor openings.
Design the covers over indoor sumps, outlet boxes, drains, etc. to be flush with the finished floor. Design the top of outdoor sumps to be 6" +/- above the top of the slab on grade in areas without vehicular traffic. Top of sumps should be 18" above the
Support small equipment on a concrete pad 6" above the finished floor.
Route piping drains and overflow outlets to trench drains.
Locate drains away from walkways, work areas, and the structure perimeter.
Provide drainage for all floor areas, especially around elevated equipment pads.
Provide a minimum amount of slope on concrete exterior walkways and platforms to prevent puddling of water.
Note on the contract drawings the existing and new floor design loads to aid the constructor in determining material stockpile locations and heavy equipment maneuverability.

Design the top layer of floor slab reinforcing to be spaced at no more than 6 inches on center each way to provide a stable, continuous walking surface before placement of the concrete.
Specify the required in-place density of subgrade soils for slabs on grade as a percent of the maximum laboratory density.
Specify the compaction requirements of the backfill around foundations. Contractor should schedule the completion of the backfilling as soon as possible.
Specify broom finish (non-slip walking surfaces) on floors adjacent to open water or exposed to the weather.
Containment will be provided around the slurry tanks, JBR, and transformer.
Guard posts are required to protect steel bents and structures from trucks or loaders in vehicle access areas.
Guard posts are required to protect equipment adjacent to vehicle access areas.
U-drain forms will be considered for this project.
Containment around Scrubber Island will be concrete curb with provisions for ramp sccess for vehicles in several areas.
Consider using bent steel form plate on elevated floor slabs around the edge of conrete at large openings and around the perimeter.
Specify composite steel form deck to eliminate formwork and minimize rebar in elevated slabs.
Specify the concrete floor finish.
When specifing a top of concrete elevation, consider the combined steel and concrete tolerance (including deflection). This may influence the beam size, composite design of floor, specifing Ff and Fl numbers for floor flatness and levelness.
When showing pipe sleeve on drawings, consider if the sleeve will be installed before or after the concrete is placed.
Limit the lift height of concrete pours to minimize the load on formwork and the risk of collapse of fresh concrete during pouring operations.
Specification should warn contractor about dangers of workers assembling formwork in high wind.
Specify on drawings or specifications if calculations and drawings for formwork must be sealed by a licensed engineer.

Specify the minimum compressive strength for removal of elevated forms supporting the weight of concrete if different than the specified compressive strength of concrete.
Specify if the alternative methods for evaluating concrete strength for formwork removal are permitted.
Consider using round piers or columns instead of odd size rectangular columns. This would simplify forming operations and permit the use of disposable tubes.
Consider specifing sacrifical formwork, sheet piling and lean concrete below grade so that backfill can be placed before the concrete.
Standardize building bay spacing to maximize the using of gang forms on grade beams and walls.
Dimension concrete foundations and structures to make the maximum use of commercial forms.
Review design of formwork for chimney and JBR foundations.
Do not specify the use of masonry materials or liquids which contain toxic substances.
Investigate the hazards associated with the specified construction materials and alert the constructor of the necessary safety precautions.
Allow for a large, unobstructed, open area (limited access zone) below elevated masonry work to minimize the risk of workers being struck by falling objects. See Section 1926.750 of the Code of Federal Regulations.
Minimize the size and weight of masonry blocks.
Use masonry blocks of consistent size and shape.
On larger masonry blocks, provide cast-in handles or handholds for easy lifting.

Specify required grade, types, and sizes. ASTM A 706 is expensive and not readily available.
Design concrete members to be of similar size and regularly spaced to facilitate the use, and re-use, of pre-fabricated forms. Consider using shotcrete where conditions warrant.
Use a metal deck and concrete fill rather than a slab that requires temporary formwork.
Use small sized rebar for framing members at elevated floor levels. Design the rebar such that it can be assembled on the ground and erected in large sections.
Show splice location and splice lengths on the drawing.
Standardize on a few sizes of rebar such as 5,7, and 10 so that two smaller sizes can be substituted for one larger size.
Show vertical wall and pier dowel extenting to 6' height, where practical, instead of using dowels and a vertical bar.
If the wall has 2 faces of reinforcing steel, place the horizontal wall rebar on the outside of the vertical bars. This eliminated threading the rebar into position.
Discuss with our construction services civil person, the areas we need to specify rebar caps other than dowels and wall vertical bars.
Specify and use water-base concrete admixtures. Job site needs access to admixture MSDS.
Design signs with rounded or blunt corners, free of sharp edges, burrs, splinters, and other sharp projections. Orient fasteners so that they do not constitute a safety hazard.
Design and schedule traffic and emergency signs for erection early in the construction phase.
Ensure proper position and location of warning signs to clearly alert workers of hazards.
Signs installed at the plant site should be in English and Spanish or have a picture or diagram to communicate the hazard or safety information.
Ensure that warning signs, controls, and alarms are standardized throughout the project.
Ensure that hazardous areas are identified, classified, and provided with adequate boundaries.

Provide signs, lights, alarms, etc. to ensure safety near dangerous equipment or areas.
Provide signs which describe the allowable floor loading.
Provide emergency showers and eye-wash basins in areas where personnel might come in contact with highly toxic or poisonous materials.
Stencil the capacity of hoist beams
All continuous, intermittent and impulsive sound levels from 80 decibels to 130 decibels shall be integrated into the noise measurements.
Instruments used to measure employee noise exposure shall be calibrated to ensure measurement accuracy
Employees shall be fitted with hearing protection
Each scrubber tank will have a stair.
Fiberglass outlet duct and duct before chimney breaching will have a platform that runs below the expansion joint. One end of the platform will be wide enough to install a 4-foot square scaffold. Platform with short stair will provide access to the man
Caged ladders or stairs are being considered to provide access to the utility bridge at 90 degree turns. Plant personnel will be provided access for equipment maintenance.
Ventilation is required for the temporary metal building over the JBR. (This item is not in the SCGEN engineering scope of work)
Construction workers, plant operations, and construction services personnel need to know the health and fire dangers associated with spraying FRP resins and working around solvent materials.
Consider ground assembly of 7 JBR steel roof beams and 6 fiberglass panels. These 8 panel assemblies can be lifted with the steel framing (rigging material) that was used to assemble the panels.
Specify communication of hazards, storage requirements of hazardous materials, and disposal and clean-up requirements of hazardous materials.
The existing engineering and procurement schedule provides inquiries for anticipated fiberglass shop fabrication.
Ensure that the Ammonia Detector meets the Performance Requirements set in ISA-92.03.01
Ensure that the Ammonia Detectors are installed and maintained as per the requirements in the ISA-RP92.03.02
Mount Ammonia Leak Lights and/or Beacons high enough to be visible in the surrounding area.
Develop P&ID's with Primary and Secondary isolation valves up-stream and down-stream including Clearence vents and Clearence drains of all equipment, ie.. Motor Operated Valves, Air Operated Valves, Orfice Plates, Steam Traps, Strainers, pumps, compressors, instrumentation. All piping designs must support SCG-SH-0200, OSHA CFR 1910.269, and CFR 1910.147.

Provide a Teflon coated plate at the sliding support location. See Crist Unit 6 SCR Ammonia tank foundation for sliding joint detail. See vendor sliding joint data at: http://www.con-servinc.com/csa-b.htm
Are architectural painting systems standardized?
Are acoustical ceilings, wall coverings, vinyl and ceramic tile standardized?.
Is the specification for pipe painting a single color, using labels to identify pipe usage?
Are special coatings needing placing prior to installation of equipment identified?
Is the scope interface definition for electrical, instrumentation, piping and mechanical equipment clearly defined in subcontract packages for buildings?
Is the structural steel fabricator supplying the miscellaneous items such as frames for louvers, vents, HVAC supports, clips, etc. that are shown on Architectural drawings and not on Civil/Structural drawings?
Has the project mazimized the use of grating floor systems?
Are building bays standardized wherever possible?
Are door hardwares and fixtures standardized?
Does the substation floor design (embedded channels) support successful roll-in / roll-out of breakers for switchgear?
Is the project using magnetic door seals in lieu of surface mounded adjustable type?
Does the elevation of computer floor (where applicable) is adequately allow cable run tie-ends to equipment?
When referencing codes, be sure to site specifics portions of a code rather than the entire code.
Are multiple design reviews being held to avoid inteferences between HVAC and fire protection / sprinklers?
Can Floor Levels be Standardized?
Is adequate space available in air handler locations to accommodate removal of steam and chilled-water coils?
What checks are being made to ensure ductwork does not interfere with piping and electrical?
Are maintenance requirements being considered when designing HVAC systems. (They are often roof-mounted with poor access and no provisions for hoisting equipment to remove and replace heavy motors and coils).
What design methods are being used to minimize roof penetrations for HVAC ductwork, piping / conduits and structural steel?

What is design considering toprevent coils from freezing when coils are inactive during periods of low temperature.
Have all block-out requirements been completed? Are electrical bus duct locations part of that evaluation?
Is control room rack flooring going to be done early to support the installation of Halon system, DCS and consoles?
Is masonry schedule early in the schedule to allow other trades to begin work sooner?
Are all sprinklers, ductwork, and electrical scheduled for installation prior to suspended ceilings?
Is siding scheduled for procuremnt earlier enough to support building dry-in?
Install roofing scheduled to support building dry-in or earlier?
Will all doors frames (any kind of frames) associated with Masonry construction be ordered and received to avoid any Masonry rework?
When will elevator specification be complete and does it support and early order and delivery of the elevator?
When will lab equipment specification be complete and does it support and early order and delivery of the lab equipment?
Are the recessed mounted toilet accessories scheduled for early delivery?
Are HVAC & Fire Detection on the critical path and does their installation bare directly on the testing of control equipment. Does schedule support the testing schedule?
Is the design of the control rooms, rack rooms, and MCC rooms HVAC scheduled for early release to support the environmental control of these rooms prior to installing DCE and variable speed drive cabinets?
Is the purchase of mounting curbs for rooftop equipment scheduled early enough to allow their installation prior to completion of roof installation.
Are glass and mullion strips specified and order early to support the schedule? These are usually long delivery times.
Do design methods allowinstallation of equipment room walls after placement of large equipment?
Are erection sequences and priorities for off-site shop fabrication of ductwork complete? Implement procedures to monitor the fabricators progress to ensure compliance.
Has the ductwork that must be installed prior to piping and electrical been identified and will be ordered early to aleviate delays or expensive construction?
Do all interior door designs consider accommodating mobile and process equipment in and out of the building?
Consider future maintenance requirements during design of structures, especially fireproof rooms and walls; i.e., use kits for wall penetrations of cables and piping; and access panels and doorways for removal and replacement of equipment.
Layout and detail all of the utility floor, roof and wall penetrations and show on Civil / Architectural drawings.
Review block-out requirements and assure correct location for electrical bus duct locations.

Avoid excavations below the water table when possible. Investigate alternate foundation schemes.
Specify different requirements concerning backfill compaction and maximum lifts for traffic vs. non-traffic areas.
Use geotechnical fabric, granular material, mud mats or lean concrete in the bottom of excavation.
Avoid the use of sheet piling when possible.
Comply with OSHA shoring requirements of excavations during foundation and U/G utility designs. Avoid deep cuts, shoring is expensive.
Establish minimum elevations for excavation. Mass excavate if possible.
Ensures that soil borrow pits and topsoil/spoil stockpile locations are identified early, prior to the civil contract bid.
What drawing are being issued for Fine or Site / grading?
Identify locations for construction water access for site dirt work.
Use permanent roads and drainage to provide good access and mobility during construction.
Provide site water runoff disposal during construction.
Ensure that site work [cut and fill] is balanced.
Identify erosion control requirements to meet local codes, EPA and the Environment Plan requirements.
Establish survey control "permanently" so that when structures are erected, survey control monuments are still accessible.
Issue fence plans early for use in security planning.
Plan layout to gain maximum use of mobile or self-propelled compaction equipment.
Coordinate installation of underground utilities. Develop plan to ensure U/G is complete prior to paving.
Ensure typical sections on detailed drawings show requirements for bedding materials for U/G utilities.
Provide culvert schedule; consider galvanized corrugated or bitumastic coated pipe.
Maximize the use of pre-cast manholes; pull boxes and other miscellaneous concrete items.
Design & coordinate underground work by path of construction schedule.
Use common excavation trenches for U/G piping, direct buried cable and duct banks where possible.
Develop a composite drawing of all underground (foundations, piping and electrical), temporary, new and existing.
Design underground piping, grounding, duct banks and ductwork early enough so that they can be installed during the site work and foundation phase of the project.

When practical, standardize anchor bolts as follows: 1. Specify consistent material, length and thread requirements - 2. Minimize the use of different diameters *Use minimum increments of 1/4" when different diameters are required) and 3. Specify splace and nut in lieu of "J Hook" anchor.
Consider use of drilled/epoxy or drilled/mechanical systems for small anchors (<1") rather than cast-in-place anchor bolts.
Issue anchor bolt lists early, especially if there are requirements for special alloy steel or hot-dipped galvanizing.
Utilize anchor bolt "sleeves" for equipment foundation anchor bolts.
Design embeds flush with face of concrete.
Provide adequate embeds in concrete surfaces for miscellaneous attachments such as doorframes, fire extinguishers and hose reels.
Clearances for anchor bolts and embedded items to be identified on drawings.
Consider early in the project if the amount of concrete in the project warrants an on site Batch Plant. Perform proper inspection if required.
Allow flexibility in concrete design. Designate slump ranges, air content ranges, and do not preclude adding water at the site.
Incorporate small foundations into slab-on-grade design (i.e., surface mounted pads).
Design foundations in congested areas with bottom of concrete at same elevation and use common footings, whenever possible.
Extend slab dimensions 4-inches when placing walls above to accommodate setting outside form on slab.
Whenever structural and site conditions permit, design foundations to allow placement of concrete directly against face of earth, thus eliminating need for forms.
On large equipment foundations, set one anchor bolt 2"+ high to act as a guide pin when setting equipment.
Design foundations and slabs-on-grade without haunches.
Evaluate the use of standard diameter concrete piers and pedestals instead of odd-sized rectangular shapes.
Use straight, flat; easily formed shapes and surfaces instead of offsets, tapered sections, and other complicated concrete shapes.
Standardize building bay dimensions.
Avoid circular foundations for equipment greater than four feet in diameter. Foundation should be octagonal or other easily constructed shape formed by the use of standard forms.
Standardize foundation sizes for pumps, pipe racks, structures and miscellaneous supports.
Dimension concrete foundations and structures to make the maximum use of commercial form sizes.
Provide estimated take-off for each structure, foundation, etc., for each individual drawing.

Place foundation early in project schedule to permit ease of concrete placement. Subsequent underground piping and ducts will eliminate free access.
Use Concrete Maturity Method of Testing concrete in lieu of conventional cylinders.
Investigate costs for different types of deep foundations; i.e., caissons, H-piles, pipe, DeWaul, auger cast or precast concrete piles
Maximize the use of pre-cast manholes, pull boxes and other miscellaneous concrete items.
Design concrete structure to allow pre-cast construction where cost or schedule savings are possible.
Eliminate the use of different grades of rebar.
Reduce the number of reinforcing steel bars in a given concrete placement by using larger bar sizes and thus increasing the required spacing.
Utilize wire mesh (WWF) (flat sheets) for area paving reinforcing instead of rebar where design allows or fiber concrete.
Include permanent plant roads and area paving in the vicinity of pipe ways and other heavily trafficked areas in Site Preparation package for early construction.
Detail and provide for concrete approach aprons at site entrance and include in the Site Preparation Package.
Utilize metal zip strips for bulkheads and eliminate wood forming for area paving joints.
Maximize concrete contraction joint sawing production. Use lightweight "Soft Cut" electric joint saw while concrete is still very green.
Follow manufacturer's instructions closely concerning installation and storage of grouting materials. Be aware of remaining shelf life of product.
Develop a slurry mix of sand and cement to facilitate backfill around congested areas.
Use anchor bolt/base plate templates from vessel fabricator (vessels 48' & larger) to facilitate accurate placement.
Design finish paving early; pave only base course and utilize during construction.
Plan electrical cable pulling locations for access of equipment, for banking of cable spools and for downhill pulls.
Return cable reels promptly for credit.
The use of embedded grounding pads inside substation buildings should be installed to ground equipment when possible.
Involve key plant E&I maintenance and operation personnel in E&I checkout and start-up planning.
Storage requirements and handling procedures should be developed early so that construction can plan for heating, warehouse space requirements on such items as MCCs, switchgear and motors.
Minimize motor vehicle use. Consider using off-road specialty vehicles (four (4) wheeled ATVs or used golf carts) for transport of supervision, tools, and light materials.
Minimize engine-driven welding machine use. Consider using electric eight bank welders or compact individual inverter units.

Minimize separation between welding and weld source. Utilize totable electric inverter welding machines that can be taken directly to the point of work.
Maximize crane productivity. Consider cranes with load moment indicators and "dial in" spotting capabilities.
Minimize disruption of adjoining work by sandblasting. Consider using vacuum blasting techniques that recycle grit in a closed system.
Minimize the use of hand rigging and "bull-rigging" in installing upper level process equipment. Use miniature diesel engine rubber tire deck crane lifted from level to level by ground based cherry picker. Lightweight unit (under 6,000 lbs.) will not overload many equipment decks. Also useful in restricted space application under pipe racks.
Base selection of construction equipment on versatility, ease of maintenance and simplicity of operation. Consider use of lifts instead of scaffolding.
Define permanent system equipment that can be used for temporary power (i.e., transformers, lighting panels, and yard lighting).
Consider use of mobile light plants to provide or supplement area lighting during construction. Look at purchase versus rental and turnover to maintenance at the end of the project.
Maintain in stock items for bulk materials commodities.(maxi-min stock supply)
Insure the compressor piping hold-downs are installed per piping detail and bolts are not over tightened.
Insure the correct type of hold-down is installed in the correct location. There are (3) types, which are hole, slotted hole and long slotted hole.
Piping guides and anchors - The clearance gaps need to be correct, which is the gap between the edge of the shoe and the guide or anchor.
Deluge sub-contractor should be reviewed early and often to insure a quality built system.
Guides on vertical lines have a specific clearance allowance on the sides and back of shoes. Engineering could design the guiding support steel to be more easily adjustable, if shoes or steel are not square.
Ensure design and inspection of temporary power complies with OSHA and NEC standards, i.e., color coding of wire.
Ensure that ground fault protection is installed on all temporary power installations, or perform monthly safety inspections of these installations.
Keep welding leads and extension cords out of walkways by: Locating power distribution panels close to the work areas; Use "Christmas Trees" to keep welding leads and extension cords off of the floor; Use stackable welding machine and Use permanently installed welding outlets.
Are safety requirements clearly defined and an incentive scheme developed?
Inspection for safety should comply with OSHA and NEC standards, i.e., color coding of wire.
Consider the need for special protective equipment and clothing.
Review project Contract for commissioning, start-up and performance test requirements.
Verify that care, custody and control transfer procedures are defined in the Contract.

Ensure that the Contract addresses or defines use of permanent plant operators during commissioning, start-up, and performance testing of the plant.
Ensure that the Contract addresses the ramifications of premature plant takeover by [Client] before contractual care, custody and control transfer.
Review Contract for methods of resolving [Client] disputes over commissioning, start-up and performance testing issues.
Develop an interface document / matrix between Engineering, Construction, Start-up to better define each group's roles and responsibilities.
Provide start-up team members the opportunity to review project design documents (P&IDs, electrical single lines and system descriptions).
Schedule meetings on a regular basis between Construction and start-up team members.
Develop and integrate the start-up schedule with the overall project schedule in order to provide a clear indication of start-up tasks and time required to perform them.
Maintain sets of as-built drawings during construction and start-up.
Ensure that the start-up team is aware of project goals, a definitive start-up plan is developed and management has "bought into" the commissioning/start-up concept.
Update all E&I required drawings at end of project to reflect "as-built" conditions.
Provide adequate number of PCs in the field to track material.
Allocate time and budget for vendor-supplied equipment document reviews and shop testing and inspections to detect design deficiencies prior to fabrication and shipment.
Establish site program/procedures that assure all equipment received is examined for specification compliance, possible shipping damage, and then properly maintained until installation and start-up.
Establish a site lubrication program based on manufacturer's specifications for all equipment.
Note: Most rotating equipment should be "turned" on a regular basis during the construction period to prevent bearing damage.
Plan on using Wal-Honde pipe alignment tools on thin wall stainless steel piping.
Outfit the site fabrication shop. Proper and adequate tools and equipment.
Utilize manufactured items in lieu of field-fabricated items such as: Toilet trailers, Shelving systems, Knockdown temporary buildings, Power distribution panels, Print shacks and gang boxes
Use CONEX Isea vans or sea trainsI with preinstalled shelving, benches, lights and HVAC for satellite tool rooms, mini warehouses and change rooms.
Provide covered storage with controlled atmosphere for sensitive electrical and instrumentation items.

Provide adequate bins and shelving for the storage of items such as fittings and small valves.
Provide racks for storing small pipe, conduit and miscellaneous steel shapes.
Provide a suitable working surface such as gravel, adequate drainage and sufficient dunnage for laydown areas.
Provide fabrication shop with adequate safe power and outfit shop with proper and sufficient tools and equipment.
Layout fabrication shop with the entire fabrication process in mind to maximize efficiency.
Prepackage satellite fabrication shops in two "Conex" containers complete with tools/equipment, prefabricated roof trusses and roofing material. Set on concrete work slab.
Utilize single in-plant contractor to maintain construction roads.
Use interlocking "Unimats" or similar system to "stabilize" and/or protect heavy lift haul roads.
Install temporary power during installation of underground utilities to reduce exposure to construction equipment. Also, route temporary power along routes least likely to be excavated during construction.
Ensure that sufficient temporary power is available for checkout and start-up or that permanent power will be available to support these activities.
Install electric drinking fountains early to eliminate the need for water cans. Locate fountains or bottled water fountains near electrical distribution panels.
Maximize the use of permanent piping systems for temporary services (air, N2, and water).
Utilize bar coded swipe cards or similar electronic time keeping system.
Consider the use of electronic security systems.
Consider the following when selecting the security contractor and setting up the security program for the project. (Ability to contact 911, Controlled access at construction gates, Security/safety of in-plant roads and parking, and Roving patrol for on-site facilities
Utilize prefabricated trailers (double wide trailers, multiple single wide, etc.) for Construction "Site" Offices.
Are temporary facilities supplied by subcontractor and owner clearly defined?
Design sanitary sewer system early to minimize use of chemical toilets.
Develop a network computer system and provide for fax, E-Mail and copying systems.
Investigate alternatives to minimize problems due to limited on-site parking - such as busing from outlying communities or shuttle buses from remote parking lots
Look at alternate parking schemes such as parking vehicles end-to-end when laying out parking lots.

Assess temporary power requirements jointly between Engineering, Construction and [Client] to ensure a safe, cost effective and usable system, taking the following into consideration: Develop one-line Elementaries, routing on plot plan with service requirements, above ground distribution system requirements
Use of new or existing permanent plant facilities for temporary facilities during construction.
Establish requirements for Subcontractors Office Trailer Area
Establish requirements for Warehouses
Establish requirements for Laydown Areas
Establish requirements for Parking
Establish requirements for Fabrication and Metal Shops
Establish requirements for Medical Facility
Establish requirements for Safety Facility
Establish requirements for Welder Testing
Establish requirements for Rigging Testing
Establish requirements for On Site testing labs (soils, concrete, NDE)
Establish requirements for Carpenter Shop
Establish requirements for Portable Toilets
Establish requirements for Resource Camps
Establish requirements for Lunch Tents
Establish requirements for Lunch Tents
Determine whether any of the permanent facilities can be made available during construction. If so and if a new facility, complete design early on the facility that is to be used during construction.
Determine whether any of the permanent facilities can be made available during construction. If so and if a new facility, complete design early on the facility that is to be used during construction.

Give consideration for systems and services that can be used during construction and transferred later on to maintenance or operations. Examples are: personal computers, spare parts software, bar code readers, 2 way radios, cell phones, pagers, portable power tools and shop equipment, pre-engineered builders and packaged air compressors
If possible, utilize the permanent fencing for job site and/or laydown area security during construction.
Preplan laydown area layout so that stored items are easy to find, maintain (if required) and remove.
Consider using pre-engineered metal structures or modular prefabricated construction for buildings and warehouse.
Expedite hydro testing. Utilize directional ultra sonic detector to quickly pinpoint leaks.
Provide clean, dry air for the checkout of pneumatic controls. Utilize permanent system or use air receiver/filter dryer to remove moisture from the air.
Discuss performance test procedures and methods with [Client] as early as possible in order to identify what will be accomplished during the testing.
Review project Contract for commissioning, start-up and performance test requirements.
Develop definitive performance test procedures and ensure they are followed.
Develop an overall test plan in order to coordinate all phases of the facility testing.
Establish guidelines for determining when the plant is ready for testing.
Consider means of simplifying and controlling flushing operation in coordination with Plant operations.
Test plumbing before constructing masonry walls.
After start-up, all slide-gate valve bolts should be re-tightened.
Establish lockout/tag out procedures to be uniformly used throughout construction, startup and operations.
Form a pre-commissioning team with Owner, Contractors) and Subcontractors).
Minimize pipe and tubing weld and preparation labor. Utilize hand-held air-operated high speed milling tools.
Maximize thin wall tubing installation productivity. For highly repetitive joints, consider using autogenous orbital welding equipment.
Maximize metal cutting productivity. Use lightweight portable add-on plasma cutting machine in lieu of oxy-acetylene cutting ("Pow Con Starcut").
Investigate feasibility of using pen-based computers for take-offs and punch lists. Plan for set-up and training time @ site.
Use bar coded identification system to aid in tool and bulk material inventory control.
Keep a sufficient supply of consumable supplies such as saw blades, files, and welding rod on hand in fabrication shops).
Provide centrally located "engineered" oxygen/acetylene bottle storage racks. Consider using bulk gas supply with a permanent distribution system.
Since the availability of open radio channels may be limited, investigate alternative means of communications such as pagers and cellular phones.

Order small tools and extension cords with twist lock plugs for temporary power usage.
Ensure that power tools have lock-on button removed before arrival at job site. Specify this requirement in small tool orders to eliminate need for removal of buttons at job site.
Utilize prefabricated temporary construction power units.
Specify use of laser type survey equipment for elevation and centerlines.
Ensure that a single punch list is used by construction and startup to track system completion requirements.
Establish requirements to be met for early turnovers to [Client].
Need early and precise definition of system packages for phased ordered completion turnover.
Develop a proper Turnover program, complete with punch listing and system statusing program.
Define and prepare system turnover packages well in advance to allow for prioritizing construction activities.
Start punch-out of facilities at earliest date possible and involve the project Process engineers. Do not underestimate the time required to complete punch list work.
Ensure all required documentation is completed as required and on schedule.
Involve plant personnel in commissioning and start-up planning. (Early)
Specify multi-pair cable, where possible.
Review use of armored cable and tray for above ground instruments in lieu of conduit.
Provide Quality tracking of instrument cable from specification to installation.
Clearly define on detail drawings where conduit seal fittings are required.
Purchase 1/2" flex conduit for instrument conduit connections (3/4" hard to work).
Use LBD fitting to enter side of instrument junction boxes for home run cables (T fitting violates bending radius of cable). (REVIEW)
Install flex coupling in locations where vibration frequencies occur.
Show instrument conduit on drawings (point to point).
Do not install ground wire on instrument flex conduit unless [Client] requests. Flex conduit has built in ground up to 1-1/4".
Ensure that door openings are designed to accommodate installation of DCS and that any required special lifting devices for top heavy equipment are included in the purchase order.
Analyzer Sample Shelters combined when applicable to one vendor / shelter. Combine continuous emission monitoring system and water / steam sample into a common shelter.
Select DCS supplier early.

Establish "teamwork" plan between Engineering, [Client] and DCS supplier.
As process information and in-line instrument information become available, procure in-line devices to support piping schedule.
Ensure that piping and instrument items related to vessel trim are specified on drawings and included on initial bulk purchases.
Review position and configuration of instrument bridles on vessels and piping for access and to prevent OBSTRUCTING walkways and platforms.
Perform thorough review of supplier drawings with regards to controls and instruments (i.e., valve motor controls and general circuitry).
Pre-assemble instrument manifolds and prefabricate instrument stands, when practical.
Engineer is to make certain that a vendor / supplier's connection drawings are crosschecked with AFC drawings to ensure the contacts to be used when terminating at an individual instrument or device are consistent.
Engineer to use the Master Equipment List numbering / tagging system on all critical E&I components. Issue a complete E&I index listing all tagged control items.
Issue wire tags from home office (package by drawing). (Utilize database to allow this)
Demo drawings should indicate instruments that will be reused to be removed before pipe is demoed.
Procure instruments of proven quality. When assembling bid list for instrument suppliers, make known any verifiable problems or negative experiences with a supplier.
Carefully check length of thermocouples prior to ordering. (Engineering review of POs).
Require that all engineered instruments be tagged with stainless steel tag by the supplier.
Specify thermal enclosures for freeze protection of instruments that are mounted outside.
When practical, specify that instruments be Ishopl calibrated prior to being shipped to the field. Critical long lead instruments need to be identified for this exercise if pre-calibration is not performed in the field.
Specify standardized instrument fittings for the project, including vendors.
Maximize use of line-mounted instruments as opposed to stand mounts when possible.
Utilize prefabricated instrument panels.
Have vendor tag terminals in instrument Junction boxes as indicated on drawings.
Ensure loop drawings include instrument set points, etc.
Ensure loop drawings encompass workstation to field device.

Consider the following concerning loop checking, calibration and testing of instruments: Issue loop diagrams promptly, Develop installation plan so that calibration can be planned and completed in an orderly manner and Set up turnover sequence, develop loop-checking plan, and identify required work force needs
Involve key plant maintenance and operations personnel in planning E&I checkout and start-up processes.
Recalibrate instruments as received at site. Instrument calibration information should be sent to the field early on. Coordinate with Instrument Support.
Pre-insulated tubing is preferable to hand insulated piping for steam tracing supply and return lines as well as for instrumentation sensing leads.
Make maximum use of multi-tube bundles.
Standardize tubing grades and wall thickness for stainless steel tubing.
Standardize tubing valves, including vendor valves.
Require that supplier furnished "packaged units" provide job standard instrumentation hardware, identification tag numbers, and specification sheets in order to properly check and calibrate these instruments in the field. Supplier furnished items shipped in crates separate from machines (i.e., compressor and turbine) should also identify items by "Bill of Material" and purchase order number.
Engineering must specify any special preventive maintenance and storage requirements for instrument hardware. Provide list and have supplier post signs on shipping crates.
DCS equipment should be set up for delivery to the job site after special environmental storage conditions (HVAC) are available.
Include supplier representative's hourly rate clauses in POs for DCS and other specialized equipment.
Consider in-house supplier representative for DCS system when configuring and developing DCS software for large projects.
Issue the instrument index as early as possible (after AFC P&IDs) so it can be used in identifying, controlling, and referencing instruments.
Review feasibility of PDS modeling all conduit and raceways of 3I and larger site wide for interference checking.
Identify on PDS modeling hazardous area boundaries on above ground electrical power conduit drawings. Refer to actual hazardous location plans
For 20 feet pipe rack bays, use non-standard 20' sections of cable tray (same cost, longer delivery).
Minimize cable trays running under welded piping.
Group elevated cable junctions in as few places as possible to minimize scaffolding needs.
Assure that cable tray barriers when required are purchased for tray fittings also.
Minimize the use of cable tray fitting when possible; do not reduce tray size for short distance when possible. Cable tray reduction positioned at structural steel to minimize need for additional tray support steel
Squad checks tray drop out support steel to assure correct location and design will allow tray to anchor to steel without adding angle iron.

Cable tray drawings should be issued along with miscellaneous structural steel supports required for installation.
Review use of Hilti studs to install tray directly to structural steel
If cable trays are stacked, there should be a minimum of 18 inches to facilitate pulling cable and installing tray covers.
The use of PVC Conduit for underground installation should be used when possible.
Conduit stub-ups under raised floors or in termination rooms should be located near doors when possible to make wire pulling less costly; avoid stub-ups directly under equipment if possible.
Review duct bank and manhole layouts to keep bends to a minimum.
Call out need for oversized fittings (if required) when sleeving cables (to meet bending radius requirements).
Show conduit routing on drawings (point to point). Indicate location of seals required for area class changes and location of expansion joints.
Route conduit and small piping, instrument leads, behind stairwells for easy installation without using expensive temporary scaffolding or personnel baskets. Very often such conduit and small pipe is designed for remote installation on the outside of the structure because "there is no interference," but is costly to install and maintain, and increases fall exposures.
Conduit connections to equipment should be flexible as opposed to rigid. Rigid conduit is difficult to align prior to equipment installation.
Conduit stub outs for building need to extend at least 5 feet beyond the building foundation
Indicate location of platform utility station locations to assure conduit and steam line awareness.
Assure that field is made aware of equipment that expands (and how much) to establish clear conduit routing locations and expansion joint locations requirements.
Minimize the depth of duct banks at all times where possible.
Maximize the use of conduit bends rather than fitting where possible on A.G. conduit runs.
Electrical drawings should reference Civil drawings that detail appurtenances (supports, block outs, embeds, etc.) to accommodate electrical conduit.
Review design to eliminate multiple runs of conduit by replacement with an equivalent tray and to improve sequencing.
Ensure that design understands that a construction deliverable is a database with which to print wire markers.
Use an equipment tagging system on all electrical equipment.
Standardize equipment, e.g., MCCs, switchgear and small transformers.
Substation modules with switchgear, MCCs, LP panels should be considered.
Utilize standard manufactured equipment whenever possible.

Determine best location of controls on equipment for safety and easy operation.
Locate oil level sight gauges for easy operator access.
Assure that all E&I equipment that appears on all single lines and wiring diagrams is properly tagged and numbered according to the specs.
Endeavor to obtain early designs for vessel electrics in order to complete electrical work in conjunction with vessel and piping work.
Establish any special tools or installation equipment required and ensures they are ordered with the main equipment PO.
Incorporate well-defined equipment specifications into one document.
Review feasibility of Underground (U/G) vs. Aboveground (A/G) cable routing.
Engineering should establish clear corridors on electrical and piping design drawings for deluge system during early design.
Portions of work which can be pushed ahead to relieve later peaking of critical crafts should be identified/scheduled.
Layout equipment for most efficient operations.
Review with plant operations and maintenance where all control/emergency stop stations should be located throughout the production area
Ensure that design meets OSHA (and [Client]) requirements for lockable disconnects within sight of equipment.
Grounding drawings should be issued before or in conjunction with civil drawings. Allow grounding under slab to be placed in sand bed under slab, rather than buried in a ditch.
The use of embedded grounding pads inside substation buildings should be installed to ground equipment when possible.
Ground wire between cable and trays and conduits as required by NEC should be shown on drawings.
Ensure that grounding clips are installed on fireproofed steel at time of fabrication.
Grounding stub up locations need to be verified with vessel and equipment ground clip locations.
PVC conduit to support ground wire should be used when possible (eliminates requirement to ground conduit sleeve).
Consider the use of fiberglass ground wells rather than the clay pipe.
The early issue of lighting plans & details for street, area, & buildings. Lighting will reduce need for the installation of temporary lighting.
Color code lighting and CKT wiring Black, red and Blue. Color code neutral white wiring with CKT color tracer.
Maximize the use of floodlighting from platforms where possible.
Utilize material consignment with electrical bulk material suppliers (such as, General Electric, Graybar, etc.)

Standardization of design installation details will enable early purchase of bulk items
Control Station supports and all other supports that require Galvanized steel should be shop fabricated & Galvanized when possible.
Ensure that Constructability reviews are performed on all design installation details to review bulk materials are covered on material lists
The types of bulk materials shall be standardized to reduce the number of different sizes and/or materials.
Pulling calculations should be part of the underground conduit design.
Issue electrical underground drawings during civil phase and MUST be coordinated with construction schedule. Avoid routing water lines over U/G cable when possible.
Long run multi-pair cable will be identified on the individual spools when they are shipped.
For underground feeders with single conductor cable, purchase this cable on three reels.
Adequate space must be considered for neat termination of cables in terminal boxes.
Specify cable reels to be shipped in upright position, not on sides, for ease of unloading, and prevent cable damage.
Provide adequate space in all cabinets, switchgear, etc., to allow for proper field installation of jacketed cable.
Review reduction of minimum depth requirements for direct buried cables.
Install pulling eye in bottom and sides of manholes (needed in bottom to hold down sheaves).
Develop or use spreadsheet software for matching cable pulls with cable reels.
Use color-coded wire on control cables.
Engineering to provide cut length schedules for power cable. Lengths will include allowances for terminations.
Standardize cable size.
Consider over-sizing electrical cables to meet construction schedule delivery requirements instead of determination of every minor electrical load.
Take steps to assure that circuit numbers for large sizes of electrical cable are identified on individual spools when they are shipped.
Be sure power supply is adequate for all panel or skid mounted equipment.
Make sure door openings are large enough to install equipment.
Disconnect switches should be shown on drawings.
Motor connection boxes should be large enough for bulky terminations, including stress relief devices. Indicate specific sizes on purchase requisitions rather than accepting standard NEMA sizes. Consider elastimold type connection (bushings) wired by supplier on large motors. Field to furnish elbow connections according to cable diameters for supplier furnished buildings.
Design electrical heat trace to support piping installation schedules and reduce scaffolding requirements. Ensure excess wire and cable can be returned to supplier for credit by including the proper language in the purchase order.

In high-risk areas, design high voltage electrical lines underground to minimize crane contact or pipe rack energization.
Purchase cable with footage markers on outer jacket when possible.
Assure field is made aware of equipment being received with impact meters attached.
Consider the use of shrink sleeves for 600-volt control cable splices, when splices are authorized.
Specify heat shrink or pre-molded stress relief devices for medium voltage cable termination.
Rigging for heavy transformers should be a pre-designed lift with a responsible rigging engineer looking at pick points and adequacy of lifting lugs in accordance with current BE&K Rigging Practices.
Design embedded floor channel (or block-outs) for supporting switchgear (in buildings) flush and level with top of floor to permit easy installation and removal of breakers. Slightly slope foundations for outside switchgear so that water will not pond around the gear.
Engineering needs to complete all design calculations for the high and low voltage relay settings and issue to field to meet substation check out schedule.
Design and review of temporary power should be done jointly between engineering and construction to insure a safe project, cost effective and usable system.
Insure that there is enough temporary power available for checkout and start-up or that permanent power will be available when the primary stages of start-up begin.
To save money the temporary power system should utilize as much of the permanent system equipment as possible (i.e., transformers, lighting panels, etc.).
Utilize twist lock plugs on temporary service.
Insure that temporary power conforms to existing SHE practices.
Engineering to establish high voltage equipment and cable testing requirements to allow subcontract package for this specialized service.
Engineering to issue interface drawings for multiple supplier equipment & specify individual vendor requirements.
Require Vendors to comply with specifications for marking terminal blocks.
Supplier to supplier connections must be carefully checked for compatibility (example: duct to switchgear).
All specialized equipment should be shop inspected prior to shipment to the field.
Pre-inspection meeting with equipment suppliers should be held very early.
Project engineer should be assigned to coordinate major equipment suppliers.

Consider operator and maintenance personnel training courses before the purchase of sophisticated machinery. (Sometimes a supplier or manufacturer will provide free training to make the sale).
Supplier skids must specify NEC code requirements clearly. Supplier skids should be inspected prior to leaving shop. Much electrical rework is associated with skids.
Plan to use supplier representative on major pieces of electrical equipment; include field terms and conditions in P.O.
Provide early requirements for chemical cleaning.
Review provisions for preventing cross-contamination.
Consider including all required information in equipment specifications. Do not refer suppliers to general specifications, insulation specifications or painting specifications.
Ensure that equipment list includes requirements for painting, insulation and fireproofing of equipment.
Ensure supplier prints reproduced from sepias are clear and readable before they are transmitted to the field.
Whenever slide bases such as at exchanger supports are required, design and procure to coincide with foundation installation schedule.
Coordinate purchase of refractory materials so that fresh materials are being used. Follow supplier's recommendations on installation.
Evaluate cooling tower materials such as treated wood, concrete, fiberglass, galvanized steel, stainless steel and ceramics to optimize costs for material, labor and maintenance.
Design for heat exchangers should include lifting lugs and removable heads. Installed these items on equipment while in the fabrication shop or facility.
When possible, modularize large pieces of equipment such as furnaces and boilers.
Ensure that the area required for tube bundle removal is clearly indicated on the equipment arrangement, mechanical and piping drawings. Ensure that circulating water and other piping are designed for ease of removal in these areas.
Test run all new equipment at the factory whenever possible. Test results should become a permanent part of supplier documentation.
Issue project specifications for plumb / level / alignment of vessels early in project. (i.e., level by trays at shop)
Review equipment for complete supplier documentation (i.e. parts lists, recommended spares, predictive maintenance specifications, repair manuals and design specifications
Review equipment for factory spare parts policy.

Review equipment for commissioning spares and initial operating spares with original equipment purchase
Review equipment for extended warranties for up to 12 month after start-up, when possible
Review each piece of equipment in the SHOP to ensure as much work as possible is completed by vendor (i.e. vessel internals, pre-assembly, etc.)
Ensure that ALL stress relieved equipment is clearly marked prior to leaving shop.
Agree to a master equipment numbering system before ordering plant equipment. The supplier (or factory) should be responsible for tagging all equipment. All associated vendor documentation should include reference to the Master Equipment List number.
Equipment standardization for a project is critical. Major equipment often does not lend itself to standardization but minor equipment does; i.e., controls, electrical components, valves, tubing fittings, small pumps, hydraulic motors and couplings. Note: Standardization reduces spare part requirements and maintenance personnel training.
Keep instrumentation and operation valves outside noise enclosures.
Ensure finish painting of vessels and equipment in vendor's shop.
Shop-apply fireproofing / painting / internal coatings where practical.
Provide sufficient clearance between insulation jacketing, platforms, ladders, pipe guides, etc.
Equipment list should list requirements for painting, insulation and fireproofing.
Encourage requirements for shop assembly, match marking and dismantling of equipment that may have fit-up problems.
Provide shop and field inspection criteria for all process equipment.
Require bill of materials and supplier's drawings for equipment supplied prior to or at time of equipment delivery. Ensure items such as gaskets and bolts are included in bill of materials and shipping lists.
Select equipment based on total installed cost and not just on initial purchase price.
Provide engineering in supplier's facilities when required to assure fabrication approvals, material ordering and fabrication schedules are not impaired.
Consider the U.S. might not be a viable source at this time for vessels with wall thickness of 5" or greater.

Consider vessel grouping for fabrication and go to one supplier and/or a geographical location.
Develop list of preferred suppliers
Review past experience and record from supplier evaluations
Identify and specify marking for vessel internal materials such as balls, clips, trays and sheds. Instruct fabricators and inspection to package, install, ship and otherwise keep separate all such materials.
Establish a program to expedite, receive, catalog, file and distribute all requested documentation during the project. "Holdbacks" should be negotiated with equipment suppliers to ensure compliance with document requests. After start-up and turnover, one or more complete master sets of data should be formally transmitted to [Client].
Some air permits require extended warranty and service periods on pollution control equipment. Determine how to provide for such under the original purchase order or alternate means. Make a general statement for items where an extended warranty is required or desired.
Show all pump seal water requirements on separate pump trim drawings with the type of service connection requirements, instrumentation (FI, PI) and valves.
Shop-mount direct coupled pumps and motors where possible.
Establish requirements for supplier's technical assistance for erection, start-up and run-in of equipment and include requirements in purchase orders.
Ship bolts, gaskets, etc. with equipment not only for construction but also commissioning and start-up spares.
Ensure that base plates have adequate size and number of ports for adequate grouting.
Clearly define on the drawings all alignment tolerances, hot and cold, where required.
Maximize the use of in-line pumps when process and specifications allow.

Consider maintenance requirements when designing equipment layouts. Allow adequate space to isolate one piece of equipment for maintenance activities while nearby equipment remains in service. Some hazardous operation areas require special design such as double block and bleed (dual blind pipe flanges) in addition to normal valves on compressor piping.
Determine safety requirements on all equipment; i.e., gears, chains, belts, hot equipment, toxic fumes, and radioactivity. (Guards must be easily removable for maintenance). Study supplier documents and consult with safety professionals.
Consider the need for special protective equipment and clothing. Study supplier documents for requirements.
Refer to manufacturer's operating specifications and define maximum / minimum limits of equipment performance.
Determine equipment and / or processes that can be operated beyond design limits. Install fail-safe limiting devices.
Engineer must detail equipment guards for large rotating equipment.
When machined surfaces are required for an item, check with Engineering before welding on any machined item. Specify desired quality or grade of machined surfaces) on applicable drawings. Also, indicate if machining is to be done after fabrication in shop.
Verify that piping checks all final nozzle locations prior to drawing approval and fabrication.
Identify portions of mechanical work that can be worked early to release-related piping, electrical and instrumentation items, thus relieving later peaking of critical craft loading.
Consider schedule deliveries of weather sensitive equipment and materials within reasonable periods of construction needs.
Large transfer lines, slide valves and like items must be engineered and fabricated for installation incrementally with the structure and vessels.
Give priority to oil mist systems so that rotating equipment can be run prior to mechanical and electrical completion, if needed.
Ensure drainage system for skid-mounted equipment has been included in the design drawings and specifications.
Specify major equipment skids such as turbines with lube oil systems integrated as part of the skid so that oil flush can be performed in the shop.
Ensure that skid mounted equipment has adequate framing to prevent warping during shipment.
Ship bolts, gaskets, etc., with equipment not only for construction but also commissioning and start-up spares
Provide procedures for preventive maintenance of items in storage as well as installed items prior to start-up.

Issue a complete lube oil and lubrication schedule prior to arrival at job site of first rotating equipment. Consider preliminary issue if required. This must include the owner's requirements as well.
Engineering should expedite supplier's operation, installation and maintenance manuals for packaged systems, pumps, compressors, agitators and other rotating equipment to ensure availability prior to receipt of the equipment.
Ensure that flange protection is provided during shipping, storage and installation of all vessels.
Consider maintenance accessibility in the final decision on all equipment locations and equipment accessories like control cabinets, valves, power units and filters.
Perform a Reliability Centered Maintenance analysis on equipment.
Consider long-term repair costs and potential equipment downtime when approving plant equipment specifications; i.e., built-in lubrication systems, waterproof motor instead of standard types, alloy materials instead of coatings, corrosion resistant materials in wash down areas and non-friable insulating materials in high heat areas.
Require in bid specifications that supplier / vendor design and provide any special lifting beams for equipment or components required for lifts. Especially for condensers, turbines and dryers. Require that these required components be shipped to the site for delivery prior to equipment arrival.
Have vendors provide erection procedures for compressors, pumps, stacks, or any special lifting requirements. Ensure that material requisitions require this.
Specify jacking pockets for shipping saddles so non-hydraulic trailers can be utilized.
Ship vessels with lifting lugs located so that vessels do not have to be rolled / re-oriented at site. Take in consideration insulation thickness and weight in lifting lugs design to have equipment insulated in horizontal position prior to setting. Specify on drawings lifting and ground lug removal plan if required.
Place center of gravity (CG) & shipping weight on all vessels, particularly horizontal equipment (tanks, bullets, etc.).
If equipment locations are revised or other revisions affecting rigging plans occur, ensure that the flow of information between design and construction is executed expeditiously.
Specify ALL shipping attachments and temporary bracing are clearly marked (i.e. painted orange) for removal after erection.
As early as possible, the Engineer should provide the following information to formulate a Preliminary Master Rigging Plan: Equipment list with weights and dimensions, plot plans, equipment drawings and proposed mode of transportation & delivery schedule

Clearly define all test procedures for overhead cranes and other mechanical handling equipment.
Study the effect of crane and other equipment movements upon the permissible density of workers in congested areas and plan shift work to relieve overload problems with either equipment or people.
Use anchor bolt / base plate templates from vessel fabricator (vessels 48' & larger) to facilitate accurate placement of the bolts in the foundation.
Analyze vessels for any special shipping requirements. Provide roundup ring girders or other bracing if required.
Indicate minimum pressurizing temperatures (ambient, vessel and water) for hydro testing.
Consider equipment pre-assembly prior to setting. For example, install handrails, platforms and apply insulation and paint. Design stacks with flanged connections if possible.
If at all possible, vessels with cyclones should be engineered for erection with the cyclones installed into the head at ground level and lifted as a completed assembly.
Verify that dimensional tolerances are correctly specified and fabricated for trays and internals.
Perform a cost analysis before specifying carbon steel tanks with interior coating.
Provide shop installed crimped bar for insulation support on bottom heads and inside skirts.
Check project requirements for fireproofing inside of vessel skirts. Eliminate by having only one opening in skirt.
Provide sufficient clearance between items such as insulation jacketing and platforms, ladders and piping guides.
Provide grounding lugs on all tanks and equipment for field installation of grounding cables especially anything with a protective interior lining. Orient equipment and lugs for embedded grounding termination.
Develop ladder and platform drawings early in the design in order to support installation before erection of the vessel. Have vessel platforms fabricated to the fullest extent possible.
Clearly specify any requirements for coating of stud bolts (i.e. grease, lubricant, paint / don't paint, etc.).
Review specifications to minimize the number of different types of gaskets and bolting. Develop color-coding system for vendor to apply prior to field receiving in field for bolts and gaskets.
Perform adequate checks on pipe supports at rotating equipment to ensure that no load is imposed on nozzles during construction or operation to disrupt alignment.
Design should review vendor equipment drawings where equipment interfaces with piping. Items to be considered are pipe diameter, schedule, material and location of connection.

Spring hangers (and heavy rod hangers) should be concentric with beam centerline.
Be alert to two-phase flow lines - check for vibrations and support. Ensure multiple interfaces with Structural Engineer.
Don't overlook checking hot and cold system piping for adequate flexibility and support.
Plan to use as many permanent plant piping networks as practical for construction lines, even if this means temporarily changing services and fluids carried and tying into temporary lines.
Expansion joints for rack piping runs should be nested together in a common location, when possible.
Minimize the gap between the issuance of revised Flowsheets. The issuance of revised ISO's and orthographic drawings (if required).
Standardize piping sub-assemblies for items such as: steam traps, utility stations, sample points, control valve stations, etc. so they can be pre-fabricated.
Check economics of reducing block valves at pumps.
Review valve locations on ASME BPVC piping to reduce the amount of code piping where this is cost effective.
Evaluate for each job whether fittings for branch connections should be shop fabricated with the header or on the lateral spools. The evaluation should consider the length of pipe rack, size of pipe, number of laterals and accuracy of design. As general rule, all branch connections should stop at the header for shop fabrication. For rack stuffing piping laterals utilizing weld in tees or weld-o-lets should have such fitting welded to lateral spools / not to headers.
Check equipment flange bolt holes for correct orientation / straddle of centerline. Check equipment at suppliers before shipment. Use slip on flange at vessel connections - field welded to ensure correct orientation.
Do not use screwed piping for any system larger than 2-inches.
Install valves for service pipe at 20', 40' or 60' intervals.
Detail all pipe penetration on elevated structures to show field welds above (4' above preferred) floor levels to minimize scaffolds.
Install unions / flanges near all critical valves to facilitate removal and replacement for maintenance.
Size the weep nipples from reinforcing pads to accommodate the thickness of insulation on the pipe or vessel involved.
"Rack stuffing" piping should be shown on Isometrics with a dotted line and field welds shown where shop fabricated spools connect to rack stuffing.
Engineering should establish clear coordinates on piping and electrical design drawings for fire protection piping and sprinklers.

Pipe specifications must include all needed information in one document. Do not refer vendors to general specifications, insulation, painting specifications, etc.
Piping isometrics and orthographic drawings should include all hydro test and process vents and drains.
All isometrics should have a detailed bill of material. Such bill of material should differentiate between shop fabrication and field fabrication and should be issued with the isometric.
Detail all pipes penetrating elevated structures.
Original isometrics of small and large bore pipe, after being prepared by design, should be maintained at the job site when "as built" drawings are required (especially ASME piping). Jobsite authority should be provided regarding changes.
Be clear and consistent in use / call out of Bottom of Pipe (B.O.P.) or centerline dimensions or elevations on all drawings.
Isometrics should be drawn for all piping, including elevation changes, direction changes, and expansion loops. Such ISO should be fully dimensioned with coordinates.
The number of line classes should be minimized.
Double check that all P&ID notes are incorporated into isometrics.
Model small bore (2" and under) as well as large bore in PDS to minimize rework.
Valve handle orientations should be shown on the ISO / orthographic drawings.
Mark field welds and field fit-up welds on Isometrics before they leave the engineer's office. Field Fit-up Welds must be provided with 3I to 6I of pipe for field fit purposes.
Design engineering should furnish routing schematics for cooling, seal and lube piping.
Do isometrics have Post Weld Heat Treatment callouts?

Do isometrics have Boiler coded work and limits callouts?
Do isometrics have NDE requirment callouts?
Do isometrics have Bi-metal, alloy and field weld callouts?
Do isometrics have gussets or special bracing callouts?
Do Isometrics have jacking bolt hole drilling callouts?
Do Isometrics have paint, coating and insulation requirement callouts?
Do Isometrics have cold spring requirements at specific locations callouts?
Do isometrics have stress analysis callouts?
Do isometrics show system, WBS and CWP numbers?
Do isometrics have test medium and test pressure callouts?
Do isometrics show operating pressures and termperature callouts?
Does line list include insulation requirements (thickness and type)?
Does line list include paint specification?
Does line list include size and number of steam & electric tracers
Does line list include turnover system reference

Does line list show test package references
Does line list show "To and From" references
Does line list show P&ID references?
Does line list show test pressure and medium?
Does line list provide seal water details for process equipment
Isometrics should be made for equipment trim and issued as early as possible (vessels, pumps, exchangers, etc.)
Consider pipe bending in lieu of fittings. Pipe bending will improve on shop fabrication delivery schedule time because of less welding and NDE inspection
Leave a field weld at the last flange on all rotating equipment on shop fabricated piping. (Shop fabricator should ship flange tacked to spool).
Consider maximizing shop fabrication regardless of size by remote vendor shop including repetitive assemblies (steam trap assemblies, utility stations, steam trace manifolds, sample coolers, etc.)
Check straight run pipe for the pipe racks, including steam tracing, to see if it is practical to fabricate into lengths up to 80 feet. Sandblast prime and topcoat (if required) and install with the pipe rack steel as the tiers of the rack are installed. Purchase double random lengths where possible.
Fabricators should be selected by reason of their proven ability to meet required schedules and fabrication accuracy rather than solely on a price basis.
Maximize shop fabrication of instrument bridles and other piping assembles.
Pipe clearances between pipes, structural members, equipment, etc., should be sufficient to avoid field trimming of insulation (Including shoes on steam traced lines).
Isometrics and orthographic drawings should clearly denote insulation limits for personnel protection, steam tracing and acoustical and insulation spec break points.
Vessel Trim Drawings for level gauges and switches, etc., on towers should have vertical and horizontal dimensions, particularly in its interface with insulation and not be classified as "field run."
Prime and top coat shop fabricated pipe. Use paints such as aluminum oxide on field weld preparations. Tape field-welds to avoid painting the weld heat area.
Specify pre-insulated tubing in lieu of hand insulated piping for steam tracing supply and return lines, where practical.
Maximize pre-painting and use of maximum of two-coat paint applications and include in pipe fabricator purchase order.

Vendor supplied piping should be shown on isometrics and orthographic drawings and identified according to vendor piece marks.
Spool piece numbers will be shown by the engineers with a method differentiating between offsite shop and field spool fabrications.
Have line ID tagged in large letters on beams supporting all pipe headers (size, number, and class). Incorporate into BID instructions.
System or area color coding (circumference stripping) should be used for shop fabricated spools and should be shown on each isometric drawing.
Utilize maximum-minimum system for small bore piping materials, bolts and gaskets.
Use field engineers for material take-off checks in the home office.
If any coded work is required on the project, the piping bulks must be purchased with "mill test" papers.
A piping specialty list should be maintained for tagged items such as de-superheaters, ejectors, in-line strainers and any other tagged piping items.
Preliminary Material Take-offs (MTOs) should include non-engineered pipe supports (shoes, guides, anchors, etc.) for early purchase and fabrication.
Run cost analysis on using all stainless steel for lube-oil systems. Clearly define cleaning procedure. Avoid bottom connections.
Ensure installation manuals and procedures are available for nonmetallic pipe (i.e. GRE, HDPE). Set-up supplier interface.
Design and order valves early. Evaluate the risks of ordering valves based on P&IDs prior to rev. 0 against potential schedule delays.
Valves with welding ends and soft seats or internals that can be damaged or destroyed by field welding should be provided with 6-inch nipples attached by the vendor or develop other protection plan.
Carefully check for correct valve trim, bolts, packing, gaskets and flange facing specifications prior to ordering valves.
Ensure valve manufacturers provide care and protection procedures for gland packing, soft seats, etc.
Engineering to identify need for and order temporary strainers.
Provide specifications for preventative maintenance and storage requirements of specialty items.
Maintain operability of a system after a tie-in has been made and before the start-up of the new system. Consider providing a block valve or spec blind with weld neck flange to isolate the new system from the existing system.
Identify tie-in procedures (i.e., unit shutdown, system shutdown and hot tap) early in the design phase. (Test pressure and test methods, test medium and items to be removed for pressure test, Tie-in method, welded, flanges and blind and or isolation rquirement and ideinfication numger
Identify and prioritize tie-in material on purchase orders.
Specify tie-in NDE requirements where tie-in of pipe to operating plant makes hydrotesting impractical or impossible. consider 100% N.D.E. of welds

Verify and field check quality of piping to be tied into before final design and fabrication of tie-in spools for integrity, ability to isolate, material spec. / thickness and interference's. Identify all tie-in locations with tie-in ID Tags and develop a detailed tie-in listing.
Provide early issue of types of metals / alloys to be utilized and Wall Thickness Schedules.
Engineering to provide isometric issue forecast curve, with input from Construction.
Finalize designs and release for construction of all larger lines early in the program. Smaller pipes can follow in agreed staged sequences.
Encourage preparation and early release of separate pipe hanger and support drawings so that specialist crews can install supports ahead of erection crews.
Design the deeper underground piping systems first.
Priorities for off-site shop fabricated piping should have input from Construction.
Commit upon firm sequences for spool fabrication and delivery with the fabricator and maintain procedures to require them to follow the program even if this means that they cannot do all like items together or work in other ways to sustain shop efficiency at the expense of field inefficiency. When necessary a special schedule / expeditor can be designated for the pipe fabricator's shop. Provide for routine inspection visits of the fabricator's shop.
Identify for early fabrication, any spools, which should be lowered into basements, tunnels or other areas, prior to construction of roofs. These spools can be initially placed on the floors for later erection.
Review major pipe runs and establish sequences for dropping lines into position in a program coordinated with erection of structural members.
Design roof and floor drains early.
All engineered supports and hangers should be located with coordinates, elevations and clearly identified by tag and / or catalogue number on isometrics and / or orthographic drawings.
Check spring hanger, snubber and strut locations for interference with the structure and all rod-out connections.
Spring hanger scales should be visible from a platform or ladder whenever possible.
Minimize use of engineered supports and spring hangers. Use adjustable hanger supports and restraints wherever possible.
Don't use galvanized shoes or clamps on SS lines at high temperatures.
Consider use of mechanical fitted pipe shoes.
Piping shoes, trunnions and dummy legs should be installed on shop fabricated spools by the fabricator and should have slots for insulation banding, if required.
Base ells and other pipe support to paving shall be adjustable.
Particular attention should be taken in detailing weld symbols on hanger details. Show necessary welds that are accessible and proper size for material being welded.

Hanger components that do not require field assembly welding and are difficult to paint after installation should be shop painted with the appropriate paint system. This is particularly important for such items as snubbers, spring cans or struts.
Standardize components used in hanger fabrication.
Hydraulic snubbers must be installed with the oil reservoir plug on top for maintenance checking.
Permanent hangers and supports should be designed and fabricated early. These and all associated materials should be delivered prior to arrival of pipe spools. Encourage preparation and early release of separate pipe hanger and support drawings so that specialist crews can install supports ahead of erection crews.
Don't use base spring cans where large horizontal movements are anticipated.
Avoid using tall "toothpick" type pipe supports, especially in seismic or high / gusty wind areas.
Establish clear parameters on testing requirements for tie-in valves or other tight shut-off valves. Specify leakage rate requirements and have valves tested by vendor prior to shipment.
Agree early to procedures and mark drawings in the design stage on method to test flare and other large lines. Verify structures are designed for hydrotest weights in vapor lines
Where chemical cleaning is required, design piping accordingly with adequate connections, drains, break out flanges to facilitate full circulation, draining and drying
Isometrics for compressor suction piping or other systems requiring chemical cleaning should have specific notes, which require removal of any internal protective coatings such as "black lacquer" in the SHOP.
Engineering should provide specifications and criteria for NDE requirements (RT, PT, UT, etc.) with construction and [Client] input.
Provide early definition of chemical cleaning requirements, i.e., specifications to be used, valves required and lines.
The Design Engineer along with Construction input should identify testing and cleaning systems by marking up P&IDs.
The engineer should specify which services can be service tested (cooling water, drinking water, instrument air, plant air, etc.) in lieu of pressure testing. Should be able to service test all category [D] piping.
Consider steam testing of piping designed for steam-out conditions in lieu of hydrostatic testing.
Develop a set of System Boundary P&IDs, which are color-coded by turnover systems. Incorporate databases with a field for system identification early in design that includes line lists, equipment lists and instrument indexes etc.

Enter into discussions with the start-up and commissioning group early in the program so that the required final systems sequences can be worked backward into the initial planning.
Provide [Client] a master set of piping specifications and welding procedures at end of project. They should include all data reports and quality documentation.
Field construction engineering to keep accurate IAs BuiltI dimensions and coordinates of installed underground piping and components.
Where feasible underground piping should be located so that multiple installation can be achieved with a single excavation particularly at road crossings.
Specify adjustable drains and cleanouts, when possible.
Underground piping and electrical conduit should each be run at consistent elevations in zones, whenever possible.
Provide all drain piping with adequate clean-out access. (Assume all drainpipes will plug at some point in time.)
Engineering design utilize specifications of HDPE, fiberglass and plastic piping weight advantages, ease of installation, etc.
Ensure welding specifications allow for use of automatic / semi-automatic welding on large bore piping.
Take steps to minimize the number of required welding procedures and welder qualification procedures.
Consider the use of orbital welding and / or LOCKRING joints to reduce field welding.
Review supplier's Welding Procedure Specification (WPS) for conformance to applicable code and [Client] requirements.
Verify pipe clearance between pipes, supports, etc. will facilitate the use of orbital automatic welding equipment on heavy wall pipe.
Use flux cored arc welding on all heavy wall carbon steel piping.
Engineering should closely review the welding and non-destructive examination requirements that are imposed on supplier components for compatibility and feasibility with project's welding and NDE Standards. Suppliers should be given explicit instructions regarding tests, documentation and approval. Requirements should refer to specific sections of applicable codes. Supplier welding and NDE procedures should be reviewed by Engineering for Home Office procured components and by the Construction/ Maintenance Function for field procured components.
Group equipment so that mass excavation can be minimized and earthwork can be balanced.
Group equipment so that large common foundation mats can be used, whenever practical.
Raise and slope plot elevation to facilitate drainage during construction and permanent facility design. Consider use of temporary ditching.

Consider where emergency stop stations should be located throughout the production area.
Improve oil sight gauges for easy operator access.
Design surge stations into multi-process production lines to reduce sensitivity to exactly matching production rates.
Provide interconnecting platform between equipment.
Allow space for piping and instrumentation next to equipment.
Provide platforms on equipment to facilitate routine maintenance requirements.
Consider maintenance requirements when designing permanent walkways, ladders, stairways, platforms, and elevators.
Develop plot plan and equipment arrangement to allow adequate access for construction and maintenance. Provide wide roads and gates to accommodate cranes. Provide crane access to heavingy
rovide wide roads and gates to accommodate cranes. Provide crane access to heavy equipment.
· Provide wider than needed pipe ways and alleyways to accommodate such items as protruding valve stems, manifolds, and fire hoses. Avoid locating pumps or other equipment under pipe ways or restricted access.
Verify that plot plan/equipment arrangement and construction sequencing will not close haul routes for heavy equipment due to height, width, length and weight restrictions. Orient equipment to accommodate haul routes.
Provide stair (not ladder) access to all areas requiring routine maintenance to facilitate transport of tools and supplies required for maintenance. Provide access on as many sides of equipment as practical.
Review proposed layouts with operations personnel to provide most efficient arrangement.
Determine best location of controls to match operator areas and provide view of equipment.
· Arrange equipment as close to the flow logic as possible by grouping equipment by process system.

Review access to critical equipment for removal and replacement, especially for large items that cannot be "manhandled". Consider removable roof panels, crane lifts, elevators, and removable wall sections. Provide drop areas at grade for motors and other equipment removed for maintenance. Consider use of installed spare equipment.
Consider size of existing maintenance equipment when establishing equipment heights and locating equipment above grade. Establish aisle ways large enough to accommodate mini-cranes.
Allow space for functional expansions of facility, which will also minimize demolition requirements.
Have rigging specialist review plot plan / equipment arrangement to ensure heavy lifts can be made.
Consider maximum use of large construction equipment to set several vessels from one location by moving vessel locations to stay within the chart limits of the crane.
Provide adequate space for shower, locker, change and restroom facilities for operations personnel, if required.
Arrange equipment to support operations as follows:
Decide early whether or not to modularize either partial or full scale.
Decide on final plot plan / equipment arrangement early and hold to plan. When possible, obtain supplier input during development.
Leave end of pipe racks open for stuffing. Design pipe in sequence so it can be installed in conjunction with pipe bridge construction.
Arrange equipment to reduce length of pipe racks.
Maximize ground level construction when possible
Provide direct access ways / aisles to minimize tripping / congestion hazards and provide escape routes during emergencies
Locate new equipment away from existing equipment to minimize use of "Hot Work" permits
Separate new foundations from existing units to minimize requirements for sheet pilling or shoring
Consolidate or limit hearing protection areas
Provide locations for safety showers and eyewashes

Locate hazardous materials yellow line area compactly and continuously near edge of plant.
Locate equipment so that it is not shielded from fire monitors and is accessible for fire fighting equipment
Provide visitor access separate from operations
Locate equipment to minimize fireproofing requirements
Arrange equipment to facilitate construction sequencing.
Ensure that plot plan and equipment arrangement contingency allows for late delivery of large equipment so that other work can proceed and late arrival equipment can be set when delivered. Arrange plot plan and equipment consistent with module / skid delivery with full or partial modular program.
Provide layout of buildings and equipment to accommodate prefabrication areas adjacent to work areas and / or performed in the same general area.
Develop plot plan to accommodate temporary construction facilities (lay down area, parking lots, fabrication shops and construction offices) as well as permanent support facilities (warehouses, roads, parking lots and maintenance shops).
Provide staging space for items pre-assembled at site such as stacks and platforms
Locate waste sumps near the edge of plot.
Locate underground utility corridors so that underground work does not affect the construction of deep foundations.
Group electrical equipment in the least hazardous areas. Reduce hazard rating of equipment and enclosures.
Orient plot plan / equipment arrangement to best utilize existing infrastructure and minimize cost of electrical and piping tie-ins.
Consider underground utilities on above ground equipment location. Also consider impact on construction equipment.
Ensure that an adequate number of competent field personnel have been selected to administer the fieldwork. Screen personnel to determine their expertise in contracting of work.
Review the Project Procedures Manual for site specific requirements. Use BE&K Contract Management Manual. Incorporate Project Labor Agreement, if applicable.
Establish a drawing distribution system to ensure that new or revised drawings are delivered to the contractors) in a timely manner without causing delays to the work.
Ensure that a pre-bid / pre-award job walk and constructability meeting are required for the project.

Develop a list of qualified contractors, for review with [Client], to bid each work package.
Establish procedure, which allows for both lump sum and cost reimbursable strategy with applicable unit rates or time and materials in situations resulting in late material deliveries or scope changes.
Include detailed schedule in the contract package with sufficient detail so that the contractor's price can include a commitment to schedule.
Ensure that the project schedule is achievable and includes float for contingencies.
Ensure that scheduling and progress reporting requirements imposed on contractors) are clearly defined and included in the Scope of Work.
Ensure that suppliers are furnished a list of priorities for supply and delivery.
Build time contingency between the supplier's forecast date and the contractor's commitment date to ensure adequate allowance for material and deliveries.
Amend contracts in a timely and equitable manner to reflect authorized and approved changes.
Finalize a list of all work that will be contracted.
Man-load the schedule to obtain proper craft density and optimize productivity.
Ensure the Scope of Work is well defined and the following requirements are included in the Contract plan: latest specifications, drawings and technical data - performanc requirements are clearly stated (i.e. hydro test, cleanup documentation and as build drawings. Additionally, the Code compliance rquirements are clearly stated, Interference responsibilities are deinfed, QA/QC reequiements care clearly defined, work areas / lay-down areas are clearly defined, the responsibility for supplying documentaion (.e. hydro test documentation, as-built drawings and safety record.
Include a provision in the Contract for weekly contractor interface meetings to coordinate activities among various contractors and to discuss progress.
Establish a procedure for tracking and documenting contractor performance.
Develop a claims avoidance plan.
Check equipment flange bolt holes for correct orientation/straddle of centerline at shop, especially on foreign made equipment.
Make project survey of suppliers and develop a list of suppliers with good track records.
Consider implementation of a supplier expediting program or procedure.
Establish shop inspection program.
Audit Project Engineering for completeness of drawings to ensure that suppliers are getting quality engineering drawings.

Prior to award, survey supplier's shop to ensure that:
· Facilities are adequate and large enough to handle the work.
· Supplier has enough qualified supervisors, engineers, craftsmen, welders, and draftsmen.
Protection of piping gasket faces at site will avoid costly leaks during hydro test and start-up.
Priorities for shop fabricated piping will be established by construction.
Assure early orders for long lead items and those not available to ensure arrival to meet erection schedule (i.e. valves, strainers, traps and fittings, hose coupling, spring support).
Order underground valves and hydrants early. Completion of U/G Construction priority.
Order ample supply of spare parts for items such as valves, hydrants, etc.
Determine if pipe spools should be fabricated on-site or off-site.
Provide early issue of types of metals/alloys to be utilized.
Vendors who supply valves and other components should be selected not only by price. Past performance evaluations should be made.
Run cost analysis on using all stainless steel for lube-oil systems. Clearly define cleaning procedure. Avoid bottom connections.
Area color-coding (circumferential striping) should be used for shop fabricated spools and should be shown on each isometric.
Set up tracking system for spool piece pre-fab prior to release of first isometric.
Establish back charge procedure and unit rates for repairing mis-fabricated pipe, and include these requirements in the shop fabricated pipe purchase order.
When possible, use removable blanket type insulation on equipment needing access.

Consider maximum shop fabrication of equipment insulation.
Minimize field storage of insulation by selecting vendor who will deliver insulation in work packages.
Monitor field and shop installation and provide technical expertise as required.
Develop systems completion plans so that hydro testing and insulation can start early, thereby spreading the insulation scope over a longer period of time and reducing the peak number of insulators.
Specify structural steel coating requirements as early as possible. Consider galvanizing or cor-ten steel instead of paint.
Perform engineering cost / life study to determine most effective thickness of insulation for project.
Minimizes double layers of insulation, where possible. Use 4-inch layer instead of 2 layers of 2-inch.
Verify and detail with sketches the required "cutback" at flanges for bolt removal. Also, identify flanges that are required by specification to be insulated.
Review and verify supplier insulation requirements and specifications for compliance with project specifications and at interface points.
Develop a plan for painting tops of beams and outside of purlins and girts prior to installation of items such as floor plates, grating, siding, and roof decks.
Require by pipe or equipment support details and painting specifications that all Teflon surfaces be protected during construction and painting operations.
If inorganic zinc primer is specified, inspect and verify the application of this material. Suppliers and other applicators, require specific advice/instructions on using this material.
Specify and monitor all sandblasting materials and their application.
Specify, monitor, and inspect all pipe wrap and internal coatings applications.
Develop a program for shop painting of structural members, pipe spools, and equipment.
Develop paint specifications, including the required color schemes, early in the project so that steel, pipe, and equipment can be painted in supplier shops (standardize colors).
Require supplier painting and inspection methods for surface preparation to be compatible with the [Client]'s specifications. Use manufacturer's standard finish, if specifications allow.
Consider ambient temperature and relative humidity conditions that will be encountered during construction, as well as during plant life, when specifying paint for field application.
Consider compatibility and maximum time allowed between application of shop and field applied systems when specifying paint for shop primers and field-finish coats.
Consider maximum operating or upset temperatures and steam-out requirements when specifying paints.

Standardize primer and finish coat paint types to the greatest extent practical.
Standardize, where cost allows, the different thickness if insulation (i.e., need 10,000 LF of 2 inch thick mineral wool for 6 inch pipe and 100 LF of 1 1/2 inch thick mineral wool for 6 inch pipe - specify all 6 inch pipe mineral wool 2 inches thick).
Use in specification mineral wool versus calcium silica where possible
Piping system on vessels and heaters, plan insulation with piping and mechanical to eliminate interference and prevent inaccessible process controls.
If applicable, review and approve all special insulation applications, such as ducts, packaged units and insulation used as fireproofing.
Verify and include specified insulation requirements for electrical and control cable systems and special valves.
Be sure all steam and electric cable tracing requirements are considered when making material takeoffs.
Obtain construction input for establishing delivery sequence.
Review delivery sequence. Concentrate efforts toward and release of drawings in accordance with Construction agreed priorities. Detail erectable steel.
Apply fireproofing in the fabrication shop where practical.
Check miscellaneous steelwork items such as equipment frames, architectural items, grounding clips, etc., that don't appear on Structural drawings. Ensure these items are included in scope of supplier, contract packages or POs.
Consider utilizing galvanized structural and miscellaneous steel.
Ensure that responsibility for galvanizing structural and miscellaneous steel is specified in design and Contract documents.
Finish-coat all non-galvanized/fireproofed steel. As a minimum primer and first intermediate coat.
Review dimensions of fireproofing with fabricator and standardize dimensions.
Ensure that field connections can be made outside of fireproofing.
Standardize fireproofing types and details.
Use lightweight Cementitious or pryrocrete materials for fireproofing of structural steel.
Define fireproofing requirements early on and make sure contractor understands scope.
Minimize or eliminate the use of through-web beam connection. If this type connection is required, place seat angles on columns.
Eliminate use of boxed-in connections.

Modularization of pipe racks requires review of practicality of fabrication of lengths up to 30 meters and install with the pipe rack steel, as the tiers of the rack are installed (Include stream tracing).
Detail High Bay Steel in a manner that will allow fabrication of roof system at grounded level.
Engineer should provide Rack Stuffing Drawings for pipe rack erection and modularization planning.
Design and erect permanent stairways, platforms, and ladders as soon as practical.
Provide adequate ladders, stairways and platforms for operators and maintenance personnel to access and perform required work on production equipment. Design should include consideration for tools, material, spare parts and repair equipment requirements.
Pre-assemble in shop, to the largest extent possible, ladders, stairways, catwalks and miscellaneous platforms.
Investigate the use of various manufactured systems for handrails and free standing, pre-engineered stair towers.
Cut and band in the shop holes required in grating for pipe penetrations.
Maximize the use of grating floor systems in lieu of floor plate, whenever possible.
Standardize hole sizes in grating for pipe penetrations.
Preferably design minimum 3' 6" height parapets or railings at all roof edges. Alternatively, provide safety line tie-off points along all roof edges.
Provide tie off loops as part of building package.
Design permanent grating in opening, to be installed when opening is created during construction.
Provide safe permanent access to roofs, in order of preference: Stair. Ships ladder. OSHA ladder.
Avoid if possible. Provide mirrors, warning bells or other warning devices.
Avoid loose or unanchored materials or equipment, especially in high wind areas.
Provide safe access directly to all roof levels or from level to level (protected ladder, ships ladder, stairs).
Load limit signage. Provide physical height limit barrier as fail-safe prevention of vehicular overloading. Card or code access system. Car count system.

Provide slip resistant floor materials. Provide guardrails. In cold climates, consider ice melting cabling.
Use slip resistant materials. Use snow melting cables. Minimize slopes.
Safety striping. Provide forklift protective edge. Consider trailer restraints. Signage.
In high wind areas, provide impact resistant windows, doors and at other openings at occupied spaces.
Make provisions for scaffolding or tie-offs.
Identify evacuation assembly/communication points on site.
Provide furnishings which are balanced and not subject to overturning. Check furnishings prior to installation for sharp edges and for areas which may catch clothing or pinch fingers.
Provide recessed handles.
Provide safety operation instructions and warning signs.
Provide adequate safety standards for specified equipment.
Properly anchor furnishings and equipment.
Provide maximum floor load capacity warning signs.
Provide pedestrian circulation safety markings. Provide bollards/guardrails at potential pedestrian/ forklift conflict areas. Provide separate pedestrian circulation doors.
Provide warning markings and/or color change.
Provide safe walking surface joint covers.
Provide transition strips.
Provide slip resistant nosings.
Provide warning sign, soft protective material.
Provide warning signs. Provide emergency call devices.
Provide flame protection, eye protection devices and proper exhaust system.
Provide dust removal system. Provide warning signs.
Avoid smoke generating materials.

Specify low emission products.
Group small floor openings together to create one large opening. Provide permanent guardrails.
Provide slip resistant floor materials.
Avoid if possible. Provide mirrors, warning bells or other warning devices.
Provide warning signs. Provide adequate fume ventilation. Engage specialists to handle dangerous materials.
Provide other means (ships ladder, stairs) if possible. Follow OSHA Safety Standards (cage, rest landings, extended handrails).
Avoid low walls in circulation areas. Use furniture barrier. Avoid hidden alcoves and offsets.
Provide view windows in doors. Provide emergency call devices. Enhance lighting. Maximize view from street.
Check hardware for safe egress operation. Provide emergency call devices.
Check handrails design and detailing for avoidance of potential finger and hand injuries.
Provide horizontal muntin bars, base or markings to deter people from walking into glass sidelights, even if tempered.
Provide guardrail height railings.
Design components to facilitate prefabrication at grade and erection as complete assemblies.
Minimize number of offsets in building plan and make offsets a consistent size and as large as possible to simplify work area for construction workers.
Provide secure tornado shelter of 5 s.f./person in tornado prone areas.
Provide emergency call system where persons work alone.
Note bearing walls on drawings.
Provide code clearances, escape path(s). Consider increases to code clearances.
Provide safe lighting levels, including access. Consider exceeding IES recommendations. Consider emergency warning call system. Consider security systems.
Provide safe lighting levels, including access. Consider indicating pathways and adding tie-offs.
Provide safe lighting levels, including access.

Provide safe lighting levels. Consider exceeding IES recommendations. Consider warning light(s).
Properly anchor and/or support electrical equipment.
Mount emergency lighting in stairwells to be easily accessible, and avoid locations over treads.
Locate to be easily accessible by maintenance staff.
Specify to be maintained at all times with bulb guards, unbroken lamps, safe wiring, and grounding.
Locate out of personnel area. Consider specifying better guard.
Place light switches in best location based on circulation pattern and best viewpoint.
Provide code clearances, escape path(s). Consider increases to code clearances.
Provide emergency call system where personnel work alone. Consider additional signage, security monitoring, or buddy system regulations.
Provide adequate and easily accessible power for window washing system.
Locate out of traffic areas or use flush electrical boxes.
Use GFI and/or locate in dry areas, per code or exceed code.
Use code mandated, UL approved electrical equipment and design per codes.
Include snow melting system for handicap ramps and open stoops.
Design electrical systems components with lockout capability and readily accessible.
Design and install signage readable from 4 feet.
Provide emergency shutoff system/button.
Properly anchor and/or support electrical equipment.
Specify GFI required on all 120V receptacles.
Specify all energized electrical equipment rooms shall have signage (for example "Danger - Authorized Personnel Only - High Voltage") and all energized electrical panels to be maintained with dead front covers in place.
Only qualified/authorized electricians will be permitted to work on energized electrical equipment.

Verify grounding system design is clearly delineated.
Design to allow ease of pre-fabricated assemblies (assemble at floor level, raise to high mounting heights) Consider wall mounted equipment or access platform.
Verify pathway is clear and adequate to allow major equipment to be delivered and placed into proper location. Consider larger doors/corridors, and/or specifying equipment shipping breaks.
Require procedures/checklists for systematically starting and energizing items
Provide code clearances, escape path(s). Consider increases to code clearances.
Avoid steep slopes. If unavoidable, provide protective rails and barriers.
For public or other buildings particularly vulnerable to terrorist attack, provide substantial vehicle limiting barriers (walls/bollards) at building. Consider placing indoors or UG. Consider 24 hour surveillance.
Provide warning signs. Consider fencing or other methods to restrict access. Verify locks on enclosures.
Provide safety warning signs at manhole.
Avoid locating overhead power lines near construction areas with cranes. Avoid potentially tall landscape materials near overhead power lines.
Consider design of underground utilities to be placed using trenchless technologies.
Provide warning tape above cables/duct bank. Call for lock out/tag out of UG circuits. Call for record drawings to be correct and available.
Provide safe lighting levels. Consider exceeding IES recommendations. Consider emergency warning call system.
Provide safe lighting levels. Consider exceeding IES recommendations.
Provide clearances/escape path(s).
Provide emergency call system where personnel work alone.
Locate out of traffic areas or use flush boxes.
Properly anchor and/or support electrical system equipment.
Locate to be in safe location and unreadable by criminals.
Provide training to building owner staff.
Consider providing exterior fire alarm horns, strobes, intrusion alarms.
Design to allow ease of pre-fabricated assemblies (assemble at floor level, raise to high mounting heights).
Verify pathway is clear and adequate to allow major equipment to be delivered and placed into proper location. Consider larger doors/corridors, and/or specifying equipment shipping breaks.

I Specify guards that protect from interference with moving parts on all equipment. I In high traffic or high risk areas, specify "yellow OSHA" guards.
I Where appropriate specify, pre-manufactured, systems that limit time in trench. I Where appropriate, avoid deep trenching. For example, review proposed invert locations and look for ways to minimize depth of utilities.
I Specify that O&M manuals include protocol for entry into all confined spaces. I Where appropriate, provide signage for egress of confined spaces. I Where appropriate, provide ladders for more rapid egress. I Where appropriate, build in emergency/safety equipment.
I Avoid locating mechanical equipment in explosive environments. I Specify explosion proof fans (e.g., aluminum in lieu of steel) and explosion-proof electrical components.
I Show equipment clearances required for working on electrical components. Take particular note of spaces anticipated to be tight for space such as components installed above ceilings or in chases. I Specify all equipment to be provided with minimum clearances required by code and in accordance with the manufacturer's requirements and recommendations.
Store domestic hot water above 140 degrees F and mix to appropriate temperature, especially where hot water is used by immune sensitive individuals such as children or the infirm.
I Check sound levels of potentially noisy equipment (chillers, fans, etc.) I Avoid excessively noisy equipment (e.g., above 85 dba) that may require the use of hearing protection.
I Avoid locating equipment less than 10' 0" from roof edge. I Where necessary to locate equipment within 10'-0" from edge of roof, provide railings. orI I means of securing fall protection devices with appropriate signage.
I Specify posting of MSDS's for all gaseous chemicals used as part of building maintenance. Specify a safety ventilation system to initiate automatically and alarm. I Where appropriate, specify and show locations for breathing apparatus.

I Where appropriate, specify an alternative non-off-gassing material. I Where off-gassing materials will be introduced regularly by users, specify enhanced filtration, local exhaust systems and IAQ sensors that alarm and/or increase ventilation. I Build-up of chemicals can occur in recently constructed buildings where materials are new and at the peak of off-gassing. Specify that the HVAC system will be run at the highest acceptable outside air rate during weekends for the first month or two of building operation. I Specify in the sequence of operation that HVAC systems to start up a few hours before anticipated occupancy, particularly after long periods of the system being off. For example, instead of starting systems at 6:00 a.m. on Monday morning, start them at 4:00 a.m.
Design for the lowest practical delivery temperature of hot water to fixtures, particularly to fixtures used by children, elderly, or medical patients.
Locate relief from steam pressure reducing stations and emergency generator exhaust away from areas where maintenance will occur.
I Avoid locating openings in public areas. I Provide protective grate to support weight of person over opening.
I Provide floor drains in floors subject to fluids such as mechanical rooms or maintenance areas. Locate drains next to fluid handling equipment such as pumps to collect fluid leaks and water discharged during repair/maintenance. I Pipe equipment drains to floor drain (avoid tripping hazard).
Provide a light broom finish on all exposed to weather surfaces
Provide adequate railing or other means of fall protection along exposed perimeter of the building
Provide broom finish on all exposed concrete stair surfaces
In all locations where a slab depression is to remain, some warning marking, color transition or other design feature should be included to make it obvious to the user that the slab step occurs, slip resistant tread, adequate lighting
Paint kicker posts in warning colors, provide a minimum of 3 foot clear between the equipment/walkways to screen walls.
Provide a minimum eye hook and hold down point on all roofs, operable windows for cleaning from inside (creates large load on mechanical system), access path for cherry pickers.
Contact architects during design phase to assist in design of handrail and guard elements.
Provide re-bars in skylight frame to avoid fall if skylight should break.
Provide strict code compliance regarding material thickness' and fireproofing requirements

1. Increase the column strength beyond code minimums to withstand certain level blast 2. Add additional perimeter columns at mid bay for lowest two levels to provide additional level of bomb protection 3. Design perimeter beam to span double bay in case bomb explosion hits interior column 4. Review structural design to insure that measures against progressive collapse have been incorporated 5. Provide setbacks which preclude uncontrolled vehicular access to perimeter of the building
To the greatest extent possible minimize column size and quantity of solid walls in parking structures. Floor system also affects effectiveness of lighting. Double tee joists are less effective in "throwing" light.
Insure that specified traffic topping and waterproofing have skid resistant aggregates or are appropriate for reducing skids.
Use round columns in parking garages where columns impinge into the spaces to reduce potential for cars to hit
Provide bollards or concrete piers at base
Avoid hard connections across expansion joints
Install placards on all Iundefinedl potential storage room walls which indicate the design live load of that space. Install floor markings in areas which are not intended for heavy storage use. Design all Iundefined spacesI for heavy storage live loads.
Coordinate all below roof equipment with A, M, E, P disciplines
Provide 4 bolt connections for all columns to foundations
Provide flange to flange splice connection for typical detail
Provide erection bridging to meet OSHA requirements
Provide requisite guardrails and toe boards at all slab openings/edges
Provide removable yellow/black safety warning tape along all steps in floor slab, rope off area at steps, provide temporary construction ramp
DBA's should be field attached after the decking is installed.
Provide bar spacing less than 6 inches or greater than 16 inches to provide bars close enough to stand on and support weight or far enough apart to provide adequate room to step between bars.
All steel columns should have a hole in which to install guardrails and lifelines at 21 and 42 inches above each floor
Add specification requirements to require temporary anchoring of decking within one hour of placing

Provide notes on lowest level plans to require adequate soil compaction when scaffolding is soil supported.
Provide uniformity in the reinforcing specified to simplify the different types of reinforcing bars layouts to ease placement and potential for mistakes
Provide a 180 degree hook or impaling cap on the end of all wall reinforcing bars
Align post tension cables such that they are not directed towards the active work areas.
Provide grounding of structural steel beginning from foundation construction
Do not test shaft bearing capacity in presence of fuel odor, provide adequate ventilation first
Insure underpinning of existing building foundation is adequate to avoid existing foundation blow-out.
Work with project directors and managers to determine areas where temporary heavy construction loads may occur and insure structure has been designed to accommodate those loads.
l Assess soil type and caution for potential of cave-ins. l For projects adjacent to open rock slopes, require rock fences to be erected or regularly spaced benches to be cut into the slopes to smother any falling rocks.
l Keep view triangle (20') clear of berms, landscaping, signage, screen walls, parking and equipment.
l Separate traffic. Avoid complex traffic patterns. l Use thermoplastic markings or buttons rather than paint for pavement markings.
l For public or other buildings particularly vulnerable to terrorist attack, provide substantial vehicle limiting barriers at building.
l Design roadway edges with shoulders to support weight of construction equipment.
l Locate exterior walkways and platforms away from the north side of the structure to prevent the buildup of moss and ice due to lack of sun. l Provide minimum slope across exterior walkways and platforms to prevent puddles. l Provide a non-slip walking surface on walkways and platforms adjacent to open water or exposed to the weather. l Do not have unanticipated, random steps along walkways.
l Provide grade surfaces at playground areas.
l Provide name, address and telephone numbers of local utility companies on drawings. l Provide location of shut-off valves. l Require hand excavation around existing underground utilities.

l Require contractor to "pothole" for unknown underground utilities prior to excavation operations. l Design underground utilities to be placed using trenchless technologies. l Locate underground utilities and other below-grade features in areas easily accessible for excavation. Allow sufficient area around excavation for stockpiling the soil. l Require warning tape to be placed 12" above underground utility lines.
l Provide safety warning signs at manhole. l Use grated manhole covers.
l Avoid steep slopes. If unavoidable, provide protective rails and barriers. l Orient the project site or grade the site to minimize the amount of work on steep slopes.
l Provide guardrails at grade differentials greater than 30".
l Provide a 12" vertical barrier at grade differentials between 6" - 18". l Provide guardrails at grade differentials greater than 18".
l Design dry ponds. l Limit depth. l Provide childproof fencing or protective railings. l Provide protective grating at potentially fast flowing inlets and piping.
l Slow down ongoing public traffic as much as possible by using signage, flag people or by closing adjacent traffic lanes. l Minimize public access through or adjacent to the project site. Detour public traffic around project site. l Allow for pedestrian traffic to be isolated from construction vehicular traffic.
l Avoid potentially tall landscape materials near overhead power lines.