PMTurkeyCOLPEm Resource

From: Comar, Manny
Sent: Wednesday, January 04, 2012 4:33 PM
To: TurkeyCOL Resource
Subject: FW: L-2011-544 Revised Response to NRC Request for Additional Information Letter No. 026 (eRAI 5653) Standard Review Plan Section 02.02.03 - Evaluation of Potential Accidents
Attachments: L-2011-544 signed 12-14-2011 RAI 02.02.03-1 (e-RAI 5653) Revised Response.pdf

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From: Burski, Raymond [mailto:RAYMOND.BURSKI@fpl.com]
Sent: Wednesday, December 14, 2011 10:35 AM
To: Matthews, David; Maher, William; Comar, Manny; Stewart, Scott; McCree, Victor
Subject: L-2011-544 Revised Response to NRC Request for Additional Information Letter No. 026 (eRAI 5653) Standard Review Plan Section 02.02.03 - Evaluation of Potential Accidents

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, D.C. 20555-0001

Re: Florida Power & Light Company
Proposed Turkey Point Units 6 and 7
Docket Nos. 52-040 and 52-041
Revised Response to NRC Request for Additional Information
Letter No. 026 (eRAI 5653) Standard Review Plan
Section 02.02.03 – Evaluation of Potential Accidents

Reference:

1. NRC Letter to FPL dated July 5, 2011, Request for Additional Information Letter No.026 Related to SRP Section 02.02.03 – Evaluation of Potential Accidents for the Turkey Point Nuclear Plant Units 6 and 7 Combined License Application
2. FPL Letter to NRC dated August 24, 2011, Response to NRC Request for Additional Information Letter No. 026 (eRAI 5653) Standard Review Plan Section 02.02.03 – Evaluation of Potential Accidents

Florida Power & Light Company (FPL) provides, as an attachment to this letter, its revised responses to the Nuclear Regulatory Commission's (NRC) requests for additional information (RAI) 02.02.03-1. Revision bars are provided to indicate the changes.

In response to NRC request for additional information (RAI) 02.02.03 Evaluation of Potential Accidents (Reference 1), Florida Power & Light Company (FPL) provided its response in letter L-2011-331, dated August 24, 2011 (Reference 2).

The initial response to RAI question 02.02.03-1 was based on determining the largest plausible tube size that can safely be stored at the Plant Gas Storage (PGS) area for Turkey Point Units 6 & 7. This approach was not consistent with the analysis for Units 1 through 5, which used a 1,615 scf tube size. This revision specifies a tube size for the Turkey Point Units 6 & 7 site of 1,615 scf, which is consistent with and identical to the tube size used at Turkey Point Units 1-5.

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Recipients:
"TurkeyCOL Resource" <TurkeyCOL.Resource@nrc.gov>
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December 14, 2011

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If you have any questions, or need additional information, please contact me at 561-691-7490.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on December 14, 2011

Sincerely,

William Maher
Senior Licensing Director – New Nuclear Projects

WDM/RFB

Attachment: FPL Revised Response to NRC RAI No. 02.02.03-1 (eRAI 5653)

cc:
PTN 6 & 7 Project Manager, AP1000 Projects Branch 1, USNRC DNRL/NRO
Regional Administrator, Region II, USNRC
Senior Resident Inspector, USNRC, Turkey Point Plant 3 & 4

NRC RAI Letter No. PTN-RAI-LTR-026

SRP Section: EIS 02.02.03 – Evaluation of Potential Accidents

Question from Siting and Accident Conseq Branch

NRC RAI Number: 02.02.03-1 (eRAI 5653)

Pursuant to 10 CFR sections 52.79(a)(1)(iv) and 52.79(a)(1)(vi), a COL application must contain a final safety analysis report (FSAR) that shall include, among other things, the location and description of any nearby industrial, military, or transportation facilities and routes, and a description and safety assessment of the site on which the facility is to be located, including site characteristics that comply with site criteria in 10 CFR 100.

With respect to onsite or offsite storage of hazardous chemicals, guidance on these regulations is provided in RG 1.206, Section C.I.2.2.3, "Evaluation of Potential Accidents," which states that applicants should determine, on the basis of information provided in FSAR Sections 2.2.1 and 2.2.2, the potential accidents to be considered as design basis accidents and identify the potential effects of those accidents on the nuclear plant in terms of design parameters or physical phenomena.

For COL applicants referencing the AP1000 DCD, COL information item 2.2-1 states, among other things, that COL applicants referencing the AP1000 certified design will provide site-specific information related to the identification of potential hazards within the site vicinity. Safe distances for material in onsite storage facilities that are part of the standard design are included in AP1000 DCD Table 2.2-1, and COL applicants are expected to verify that the locations and size of the storage facilities are consistent with the safe distances defined by the AP1000 certified design.

The staff requests the following additional information regarding PTN COL FSAR Section 2.2.3.

a. Revise the COL FSAR to include an explanation of how safe separation distances for standard chemicals listed in AP1000 DCD Table 2.2-1 are met at the PTN site.

b. COL FSAR Table 2.2-202 lists a hydrogen gas inventory of one 40,000 standard cubic feet tube trailer located in the PGS area for Units 6 & 7. Footnote (a) of COL FSAR Table 2.2 -213, "Design Basis Events – Explosions" states that simultaneous detonation of all the tubes in the tube trailer "is not a likely scenario." The applicant explains that it assumed that one-third of the tubes could rupture, which yields a safe distance of 544 feet, as compared to a distance of 560 feet to the nearest safety related structure, which leaves a margin of 16 feet. As stated in the AP1000 DCD, Section 2.2, "The determination of the probability of occurrence of potential accidents which could have severe consequences will be based on analyses of available statistical data on the occurrence of the accident together with analyses of the effects of the accident on the plant's safety-related structures and components." Justify why there is an acceptably low probability of occurrence of an accident ($< 10^{-6}$ probability of occurrence per year) which involves simultaneous rupture of more than one-third of the tubes, detonation

other hydrogen gas, and a radiological dose in excess of the limits in 10 CFR 50.34(a)(1). Revise the COL FSAR, as appropriate.

FPL RESPONSE:

a. The calculated safe distances for material in onsite storage facilities along with the distances to the nearest safety related structure for explosions and flammable vapor cloud explosions are found in FSAR Tables 2.2-213 and 2.2-214, respectively. Included in FSAR Tables 2.2-213 and 2.2-214 are the standard chemicals stored at Turkey Point Units 6 & 7 listed in DCD Table 2.2-1. Table 1, below, provides an excerpt from Table 2.2-1 of the AP1000 DCD, including the Explosion Minimum Safe Distances and Flammable Vapor Cloud Safe Distance columns.

Table 1

Material	Explosion Minimum Safe Distance[(1)] (feet)	Flammable Vapor Cloud Safe Distance[(1)] (feet)
Liquid Hydrogen, H_2	577	175
Pressurized Gaseous Hydrogen, H_2	6	Not Applicable
Hydrazine, N_2H_4	45	Not Applicable
Morpholine, $O(CH_2CH_2)_2NH$	66	Not Applicable
3-Methoxy propylamine (MOPA), $C_4H_{11}NO$	87	Not Applicable
No. 2 Diesel Fuel Oil	280	Not Applicable
Waste Oil	102	Not Applicable

Note:

1. Safe distance is to nearest point of nuclear island SSC.

As shown in FSAR Tables 2.2-213 and 2.2-214, each standard chemical stored at Turkey Point Units 6 & 7, will be stored at a distance greater than the indicated minimum safe distances for explosion and vapor cloud explosions indicated in Table 2.2-1 of the AP1000 DCD and Table 1 above. It should be noted, as detailed in COL Departure, PTN DEP 9.3-1, in lieu of the liquid hydrogen storage tank and vaporizers, Turkey Point Units 6 & 7 will use a series of hydrogen storage banks that store hydrogen gas in banks of tubes. (Therefore, the liquid hydrogen safe distances are not applicable to the Turkey Point Units 6 & 7 site.) The hydrogen tube banks will be stored at the Plant Gas Storage (PGS) area, as denoted in FSAR Table 2.2-202. For hydrogen gas storage at the PGS area, the

calculated minimum safe distances for explosion and flammable vapor cloud explosion are found in FSAR Tables 2.2-213 and 2.2-214, respectively.

Revisions will be made to FSAR 2.2 to clarify how safe separation distances for standard chemicals listed in AP1000 DCD Table 2.2-1 are met at the Turkey Point Units 6 & 7 site. (See Associated COLA Revisions Section—specifically, FSAR Section 2.2, and Subsections 2.2.3.1.1.4, and 2.2.3.1.2.4).

b. In order to provide a comprehensive response to Part b, the response has been divided into three subsections.

Subsection 1: Hydrogen Storage Departure, PTN DEP 9.3-1, Background

As indicated in Turkey Point Units 6 & 7 COL Departure, PTN DEP 9.3-1, FPL will use a series of hydrogen storage banks that store hydrogen gas in banks of storage tubes instead of the liquid hydrogen storage tank and vaporizers. The basis for this departure and selection of hydrogen gas storage banks includes the following:

i. As provided in Table 2.2-1 of the AP1000 DCD, the AP1000 explosion safe distance requirement is 577 feet for liquid hydrogen storage—the Turkey Point Units 6 & 7 Plant Gas Storage (PGS) area is located 560 feet from the nearest safety related structure.

ii. A factor in determining explosion safe distances is the mass available for explosion—the explosion analysis considers the immediate detonation of a released cloud at the source. Therefore, the type and size of the storage vessel can affect this variable. While there have been several incidents documenting single vessel failures, no incidents could be found documenting the simultaneous failure of multiple vessels. For instance, the technical references provided in the Electric Power Research Institute's (EPRI) "Guidelines for Permanent BWR Hydrogen Water Chemistry Installations—1987 Revision" (EPRI Guidelines), list approximately 100 incidents between 1921 and 1977 where flammable/explosive gas cloud releases were produced and documented. After studying these documented releases, the conclusion in the EPRI Guidelines is that due to the inherent strength of the gaseous hydrogen storage vessel, the simultaneous failure of multiple vessels would not be included in the analysis provided in the guidelines—that is, the analysis in the EPRI Guidelines considered the maximum postulated instantaneous release as the fully pressurized contents of the largest single vessel. (EPRI 1987) Because a much reduced mass is available for detonation when a quantity of hydrogen is distributed throughout several vessels versus a single tank, the use of a hydrogen gas storage bank permits safe hydrogen storage at distances closer to safety-related structures than are acceptable for a single vessel of liquid hydrogen. (Subsection 2 provides further justification for not including the simultaneous failure of multiple vessels in an analysis).

iii. The behavior of a release of liquid hydrogen differs significantly from a release of gaseous hydrogen (See Subsection 3). These differences can play a significant role in the vapor cloud explosion analysis, yielding differing calculated safe distances for vapor cloud explosions, and permitting safe

gaseous hydrogen storage at distances closer to safety-related structures than are acceptable for liquid hydrogen. The release of gaseous hydrogen will result in a buoyant, lighter-than-air plume, whereas, the release of liquid hydrogen will initially result in a dense, heavier-than-air plume. Examples of these differences in release behavior are documented in the EPRI Guidelines (EPRI 1987), where the following excerpts are provided:

(1) When gaseous hydrogen is released in open, unconfined areas, hydrogen diffuses rapidly in air and will not form persistent flammable mixtures.

(2) When a gaseous storage vessel ruptures, the expansion of the high-pressure gas results in rapid turbulent mixing with the surrounding air. In the case of gaseous hydrogen, the release will go through the detonation limits of 18.3-59% before the wind can translate the mixture. Consequently, any explosion blastwaves will originate at the vessel rupture site. Liquid hydrogen releases, however, can produce dense plumes with flammable/detonable concentrations that can travel hundreds of feet before being diluted to a non-hazardous mixture.

(3) The major hazard from the storage and use of large quantities of cryogenic liquid hydrogen on reactor sites is that of producing flammable/explosive clouds that can drift near or be taken into air ventilation systems of safety-related structures. Cryogenic hydrogen released into the environment will form a dense, heavier-than-air plume that will drift along with wind currents and flow by gravity to lower elevations until it gains sufficient heat to become buoyant. Experimental data for a liquid hydrogen flow rate of 2-18 kg/sec indicate that plume travel is on the order of 1000 feet prior to becoming buoyant.

(4) Experimental liquid hydrogen spill tests conducted by Arthur D. Little, Inc indicate that the cryogenic liquid release to the ground will create a dense, heavier-than-air plume that can travel up to 1500 feet before absorbing heat and gaining buoyancy (EPRI 1987).

Subsection 2: Explosion Analysis Including Justification for Single Vessel Failure

The COL explosion analysis for the hydrogen storage bank system described in footnote (a) of COL FSAR Table 2.2-213 conservatively considered the simultaneous failure of one-third of the hydrogen tubes— this approach was taken to allow some flexibility in the selection of the size of hydrogen tubes that can be used in the hydrogen storage banks at Turkey Point Units 6 & 7. A re-analysis has been performed based on a single tube for the Turkey Point Units 6 & 7 site. The following justification is provided for the single tube explosion analysis:

i. EPRI Guidelines address the non-mechanistic rupture of single hydrogen vessels and the separation distances required to avoid damage to safety-related equipment. These guidelines do not encompass the simultaneous failure of multiple storage vessels, because the inherent strength of the

storage vessel makes them unsusceptible to failure from outside forces. The guidelines further state that these vessels are capable of withstanding tornado missiles and site specific seismic loading due to horizontal and vertical accelerations acting simultaneously. These features eliminate common cause vessel failures so that the maximum postulated instantaneous release is the fully pressurized contents of the largest single vessel. (EPRI, 1987)

ii. As concluded in the EPRI Guidelines, an event involving a tube trailer at Los Alamos provides a basis for assuming only single vessel failure. The event involved the explosion of a single hydrogen tube where the resulting explosion did not damage the adjacent hydrogen tubes. (EPRI, 1987)

iii. Two other events provide further basis for assuming only single vessel failure. At two different reactor sites, during filling operations, hydrogen explosions and fireballs occurred over the storage tanks but did not damage adjacent cylinders. (EPRI, 1987)

iv. The Guideline for Quantitative Risk Assessment, "Purple book", reports that the frequency of catastrophic failure of a gas cylinder (instantaneous release) is 1×10^{-6} per year. (Uijit, 2005)

The re-analysis of hydrogen stored a Turkey Point Units 6 & 7 was based on a hydrogen tube size of 1615 scf, the equivalent tube size utilized at Turkey Point Units 1-5. The explosion safe distance for gaseous hydrogen storage at the PGS area is approximately 269 feet—the PGS area is approximately 560 feet from the nearest safety related structure. To maintain consistency, the hydrogen gas tube storage at Turkey Point Units 1-5 was also re-evaluated to include the failure of a single hydrogen tube versus the simultaneous failure of multiple tubes encompassing an entire bank. The resulting analysis indicates that the explosion safe distance for hydrogen storage at Turkey Point Units 1-5 is approximately 269 feet.

Revisions will be made to FSAR 2.2.3 and Table 2.2-213 to incorporate the analyses of the failure of a single hydrogen tube, deleting the previous analyses involving the simultaneous failure of multiple tubes, at the Turkey Point Units 6 & 7 and Turkey Point Units 1-5 sites. (See Associated COLA Revisions Section—specifically, FSAR Subsections 2.2.3.1.1.3 and 2.2.3.1.1.4, and FSAR Table 2.2-213 along with footnotes (a) and (c) of FSAR Table 2.2-213)

Subsection 3: Vapor Cloud Explosion Re-analysis

While updating the analyses for explosions, the vapor cloud explosion analyses for hydrogen storage was also revised–footnote (g) of FSAR Table 2.2-214 indicated that the current vapor cloud explosion analysis conservatively considered the failure of one-third of the tubes to allow for flexibility in the selection of the hydrogen tube size banks. As opposed to the detonation at the source in the explosion analyses (immediate detonation) (Subsection 2), the vapor cloud explosion scenario considers the formation of the cloud and subsequent traveling of the cloud prior to ignition (delayed detonation).

Therefore, when performing the vapor cloud explosion analysis, conservatively, it was assumed that the entire bank was released and a vapor cloud formed (i.e. the tubes were interconnected in one bank and the failure allowed for a release of the entire bank). The behavior of a gaseous hydrogen release was also taken into account in the re-analysis. As indicated in Subsection 1, a gaseous hydrogen release will expand into the surrounding air, forming a buoyant plume—with a density 1/15 that of air. A plume of pure hydrogen can rise as fast as 9 m/s. (EPA, 2004). The assumptions in the re-analysis for vapor cloud explosion, for the determined worst-case meteorological condition, included:

i. the release of the entire bank over a 10 minute period;

ii. accounting for plume rise at the time of ignition; and

iii. using a TNT equivalency method (for spherical aerial clouds), calculate the safe distance (FM Global, 2008) to verify that the safe distance is less than the distance to the nearest safety-related structure.

The re-analysis determined that for the gaseous hydrogen storage at Turkey Point Units 6 & 7 PGS area, the vapor cloud explosion safe distance, approximately 514 feet from the point of ignition, is less than the storage distance, when plume rise is considered.

The hydrogen gas tube storage analysis at Turkey Point Units 1-5 was previously evaluated to include the failure of the entire bank. Additionally, this analysis did not credit plume rise. As demonstrated above these assumptions are extremely conservative; however, given the distance between the hydrogen storage at Turkey Point Units 1-5 and the nearest safety-related structure at Turkey Point Units 6 & 7, further refinement of the analysis to account for plume rise was unnecessary. However, the evaluated hydrogen bank size was revised to update the largest capacity of a hydrogen trailer to 58,000 scf on the Turkey Point Units 1-5 site. The resulting analysis indicates that the vapor cloud explosion safe distance for the hydrogen trailer at Turkey Point Units 1-5 is approximately 1347 feet—the distance from the Turkey Point Units 1-5 hydrogen trailer and the nearest safety-related structure is approximately 3966 feet.

(See Associated COLA Revisions Section—specifically, FSAR Subsections 2.2.3.1.2.3 and 2.2.3.1.2.4, and FSAR Tables 2.2-202 and 2.2-214 along with footnote (g) of FSAR Table 2.2-214)

This response is PLANT SPECIFIC.

References:

(EPRI, 1987) Electric Power Research Institute, *Guidelines for Permanent BWR Hydrogen Water Chemistry Installations—1987 Revision,* September 1987.

(EPA, 2004) United States Environmental Protection Agency, *Safety and Security Analysis: Investigative Report by NASA on Proposed EPA Hydrogen-Powered Vehicle Fueling Station,* October 2004.

(FM Global, 2008) Factory Mutual Global Property Loss Prevention Data Sheet 7-42, *Guidelines for Evaluating the Effects of Vapor Cloud Explosions Using a TNT Equivalency Method,* May 2008.

(Uijit, 2005) Dr. P.A.M. Uijit de Haag and Dr. B.J.M. Ale, *Guideline for Quantitative Risk Assessment, "Purple Book",* December 2005.

ASSOCIATED COLA REVISIONS:

FSAR Section 2.2 will be revised as follows:

STD DEP 1.1-1

Subsection 2.2.1 of the DCD is renumbered as Subsection 2.2.4 and moved to the end of Section 2.2. This is being done to accommodate the numbering incorporation of RG 1.206 numbering conventions for Section 2.2.

PTN DEP 9.3-1

Section 2.2 includes the evaluation of hazards due to changes in the Plant Gas System—specifically hydrogen gas storage.

FSAR Section 2.2.3.1.1.3 will be revised as follows:

Units 6 & 7 are located close to the existing Units 1 through 5 chemical storage locations. The hazardous materials stored on site that were identified for further analysis with regard to explosion potential were acetylene, ammonium hydroxide, hydrazine, hydrogen, and propane. A conservative analysis using the TNT equivalency methods described in Subsection 2.2.3.1.1.1 was used to determine safe distances for the identified hazardous materials. The results indicate that the safe distances are less than the minimum separation distance from the nearest safety-related structure, the Unit 6 auxiliary building, to each storage location. The safe distance for acetylene is 1416 feet; for ammonium hydroxide, 296 feet; for hydrazine, 170 feet; for hydrogen, ~~1098~~**269** feet; and for propane, 1299 feet (Table 2.2-213). Acetylene is stored approximately 4300 feet; ammonium hydroxide approximately 5079 feet; hydrazine approximately 2727 feet; hydrogen approximately 3966 feet; and propane 4168 feet; from the nearest safety-related structure for Units 6 & 7—the Unit 6 auxiliary building. Therefore, an explosion from any of the onsite hazardous materials evaluated will not adversely affect the safe operation or shutdown of Units 6 & 7.

FSAR Section 2.2.3.1.1.4 will be revised as follows (note, revisions include the revised storage location of the chemicals stored in the Turbine Building from Rev. 17 of the DCD):

The chemicals associated with Units 6 & 7 that were identified for further analysis with regard to explosion potential were methanol, hydrazine, morpholine, and the hydrogen storage banks. A conservative analysis using the TNT equivalency methods described in Subsection 2.2.3.1.1.1 was used to determine safe distances for the identified hazardous materials. The results indicate that the safe distances are less than the minimum separation distance from the nearest safety-related structure—the Unit 6 or Unit 7 auxiliary building—to each storage location. The safe distance for methanol is 344 feet; for hydrazine, 153 feet; for morpholine 136 feet; and for hydrogen, ~~544~~**269** feet (Table 2.2-213). Methanol is stored at the FPL reclaimed water treatment facility approximately 5581 feet from the nearest safety-related structure for Units 6 & 7—the Unit 7 auxiliary building. Hydrazine and morpholine are stored approximately ~~218~~**176** feet; and hydrogen approximately 560 feet from the nearest safety-related structure for Turkey Point Units 6 & 7—the Unit 6 or Unit 7 auxiliary building. **Additionally, each standard chemical stored at Turkey Point Units 6 & 7 is stored at a distance greater than the minimum safe distances for explosion indicated in the DCD, Table 2.2-1.** Therefore, an explosion from any of the onsite hazardous materials evaluated will not adversely affect the safe operation or shutdown of Units 6 & 7.

FSAR Section 2.2.3.1.2.3 (Paragraphs 1 and 3) will be revised as follows:

The hazardous materials stored on site that were identified for further analysis with regard to forming a flammable vapor cloud capable of delayed ignition following an accidental release of the hazardous material are acetylene, ammonium hydroxide, hydrazine, hydrogen, and propane. As described in Subsection 2.2.3.1.2.1, the ALOHA dispersion model was used to determine the distance a vapor cloud could travel to reach the LFL boundary once a vapor cloud has formed from an accidental release of the identified chemical. It was conservatively assumed that the entire contents of the ammonium hydroxide, hydrazine, and liquid propane vessels leaked forming a one-centimeter-thick puddle; while, for acetylene and hydrogen, it was assumed that the entire contents of the tank are released over a 10-minute period as a continuous direct source. The results indicate that any plausible vapor cloud that could form and mix sufficiently under stable atmospheric conditions would be below the LFL boundary before reaching the nearest safety-related structure—the Unit 6 auxiliary building. The distance to the LFL boundary for acetylene is 1308 feet; for ammonium hydroxide, 354 feet; for hydrazine, 42 feet; for hydrogen, ~~1032~~**1179** feet; and for propane, the distance to the LFL boundary is 738 feet. Acetylene is stored approximately 4300 feet; ammonium hydroxide, approximately 5079 feet; hydrazine, approximately 2727 feet; hydrogen, approximately 3966 feet; and propane approximately 4168 feet from the Unit 6 auxiliary building (Table 2.2-214).
A vapor cloud explosion analysis was also completed following the methodology as detailed in Subsection 2.2.3.1.2.2 in order to obtain safe distances. The results concluded that the safe distance, the minimum distance required for an explosion to have less than a 1 psi peak incident pressure, are less than the shortest distance to the nearest safety-related structure for Units 6 & 7, the Unit 6 auxiliary building, and the storage location of these chemicals. The safe distance for the acetylene cylinders is 1764 feet; for ammonium hydroxide, 963 feet; for one hydrogen tube trailer, ~~1182~~**1347**

feet; and for liquid propane, 1416 feet. For hydrazine, no explosion occurs because the vapor pressure for hydrazine is sufficiently low that not enough vapor is released from the spill for a vapor cloud explosion to occur. Each of these chemicals is stored at a greater distance from the nearest safety-related structure than the calculated safe distance.

FSAR Section 2.2.3.1.2.4 (Paragraphs 2 and 4) will be revised as follows (note, revisions include the revised storage location of the chemicals stored in the Turbine Building from Rev. 17 of the DCD):

The results indicate that any plausible vapor cloud that could form and mix sufficiently under stable atmospheric conditions would be below the LFL boundary before reaching the nearest safety-related structure—the Unit 6 auxiliary building. The distance to the LFL boundary for methanol is 282 feet; for hydrazine, less than 33 feet; for morpholine, less than 33 feet; and for hydrogen, 507 feet. Methanol is stored at the FPL reclaimed water treatment facility approximately 5581 feet; hydrazine and morpholine are stored approximately ~~218~~**176** feet; and hydrogen is stored approximately 560 feet from the nearest safety-related structure—either the Unit 6 or Unit 7 auxiliary building (Table 2.2-214).

With the exception of hydrogen, a~~A~~ vapor cloud explosion analysis was also completed as detailed in Subsection 2.2.3.1.2.2 to obtain safe distances. **The methodology for the hydrogen analysis accounted for the buoyancy associated with a release of gaseous hydrogen.** The results concluded that the safe distance, the minimum distance required for an explosion to have less than a 1 psi peak incident pressure, are less than the shortest distance to the nearest safety-related structure for Units 6 & 7, the Unit 6 auxiliary building, and the storage location of these chemicals. The safe distance for the methanol is 804 feet; for hydrazine, no detonation; for morpholine, no detonation; and for hydrogen, ~~432~~**514** feet **from the point of ignition**. For hydrazine and morpholine, no detonation/explosion occurs because the vapor pressures are sufficiently low that not enough vapor is released from the spill for a vapor cloud explosion to occur. Each of these chemicals is stored at a greater distance from the nearest safety-related structure than the calculated safe distance. **Additionally, each standard chemical stored at Turkey Point Units 6 & 7 is stored at a distance greater than the minimum safe distances for vapor cloud explosions indicated in the DCD, Table 2.2-1.** Therefore, a flammable vapor cloud with the possibility of ignition or explosion formed from the storage of the onsite chemical storage for Units 6 & 7 analyzed will not adversely affect the safe operation or shutdown of Units 6 & 7 (Table 2.2-214).

FSAR Table 2.2-202, Onsite Chemical Storage Units 1 through 7 (Sheet 1 of 5) will be revised as follows:

Material	Toxicity Limit IDLH[(a)]	Maximum Quantity in Largest Container	Primary Storage Location
Turkey Point Units 1 through 5			
Acetylene Gas	Asphyxiant	150 pound cylinders (3,000 pounds total)	Welding Gas House
Ammonium Hydroxide	300 ppm	(2) 20,000 gallon above ground storage tanks	East Side Unit 5 for SCR
Argon Gas	Asphyxiant	150 pound cylinders (3,000 pounds total)	Welding Gas House
Boric Acid	None Established	Fiber drums (66,660 pounds total)	Units 3 & 4 Central Receiving Warehouse/ Boric Acid Room
Carbon Dioxide	40,000 ppm	150 pound cylinders (9000 pounds total)	Compressed Gas House
Chlorine	10 ppm	150 pound cylinder	Nuclear Sewage Treatment Area
Citric Acid	None Established	500 pounds	Water Treatment Area (Units 1 & 2)
Hydrated Lime (Calcium Hydroxide)	5 $mg/m^{3(b)}$	35,000 pounds	Fossils Storage Building
Hydrazine	50 ppm	1,100 gallons (2,215 gallons total)	Stores Drum Storage Area (Units 3 & 4)
Hydrogen Gas	Asphyxiant	~~(2) 45,000~~ **58,000** standard cubic feet (2 Hydrogen Tube Trailers)	Stored in two Hydrogen Tube Trailers
Hydrogen Peroxide	75 ppm	5 gallon	Primary Chemical Addition Area
Lead (in battery)	100 mg/m^3 (as lead)	174,000 pounds	Units 1 through 5 Battery Rooms/Land Utilization Fleet Service Shop
Lithium Hydroxide	None Established	5 gallons	Primary Chemical Addition Area
Lube Oil	None Established	14,800 gallon storage tank (122,548 gallons total)	Units 3 & 4 Lube Oil Storage Tank/Lube Oil Reservoirs
Magnesium Oxide	750 mg/m^3	20,000 pounds	Fossils Storage Building
Mineral Oil	2500 mg/m3	(2) 16,180 gallons (48,997 gallons total)	Unit 1 Main Transformer/Unit 2 Main Transformer
Muriatic Acid (Hydrochloric Acid)	50 ppm	110 gallons	Units 1 & 2 Water Treatment Area
Nitrogen Gas	Asphyxiant	100,000 cubic feet	Gas House/Trailer
Nitrogen- Liquid	Asphyxiant	3500 gal	Units 3 & 4 N2 Dewar Tanks
Number 2 Fuel Oil/Diesel Fuel	None Established	4,300,000 gallon above ground storage tank (4,510,632 total)	Unit 5 Southeast Corner

FSAR Table 2.2-213, Design Basis Events -- Explosions will be revised as follows:

Source	Chemical Evaluated	Quantity	Heat of Combustion (Btu/lb)	Distance to Nearest Safety-Related Structure	Safe Distance for Explosion to have less than 1 psi of Peak Incident Pressure	Thermal Radiation Heat Flux Resulting from a BLEVE
Road: Onsite Transport	Gasoline	50,000 pounds	18,720 Btu/lb	2,054 feet	266 feet	N/A
Pipeline: Turkey Point Lateral	Natural Gas	30,302 pounds[b]	21,517 Btu/lb	4,535 feet	3,097 feet	N/A
Onsite (Includes Turkey Point Units 1 ~~thru~~ through 5)	Acetylene	3,000 pounds	20,747 Btu/lb	4,300 feet	1,416 feet	N/A
	Ammonium Hydroxide	40,000 gallons	7,992 Btu/lb	5,079 feet	296 feet	N/A
	Hydrazine	1,100 gallons	8,345 Btu/lb	2,727 feet	170 feet	N/A
	Hydrogen	~~110,000~~ 1,615 standard cubic feet[c]	50,080 Btu/lb	3,966 feet	~~1,099~~269 feet	N/A
	Propane	500 gallons	19,782 Btu/lb	4,168 feet	1,299 feet	0.0878 kW/m^2
Onsite (Includes Turkey Point Units 6 & 7)	Methanol	25,000 gallons	8,419 Btu/lb	5,581 feet	344 feet	N/A
	Hydrazine (35% solution)	800 gallons	8,345 Btu/lb	~~218~~176 feet	153 feet	N/A
	Morpholine	800 gallons	20,000 Btu/lb	~~218~~176 feet	136 feet	N/A
	Hydrogen[a]	~~13,334~~ 1,615 standard cubic feet	50,080 Btu/lb	560 feet	~~544~~269 feet	N/A
Offsite (Homestead Air Reserve Base)	Gasoline	137,104 pounds	18,720 Btu/lb	25,133 feet	364 feet	N/A
	Hydrazine	1437 pounds	8345 Btu/lb		90 feet	N/A
	Jet Fuel	23,251,606 pounds	18,540 Btu/lb		2184 feet	N/A
	Propane	185,865 pounds	19,782 Btu/lb		5513 feet	N/A

Footnotes (a) and (c) of FSAR Table 2.2-213, Design Basis Events – Explosions will be revised as follows:

(a) A simultaneous detonation of all the tubes contained in a 40,000 scf hydrogen tube bank is not a likely scenario. ~~If a rupture and subsequent detonation of a single tube were to occur the event could likely trigger another tube failure and detonation, but these events would occur consecutively, not simultaneously. Therefore, detonation of mass from a single tube in hydrogen bank is the most plausible scenario; however, for conservatism, it was assumed that a catastrophic accident could result such that one-third of the tubes could rupture and detonate simultaneously.~~ **Therefore, an explosion involving a single tube, 1,615 scf, was evaluated**.

(c) ~~Conservatively,~~ **The simultaneous detonation of all the tubes contained in a 58,000 scf trailer** ~~the total hydrogen gas capacity for~~ **stored at** Units 1–5 **is not a plausible scenario; therefore, an explosion involving the largest single tube, 1615 scf,** was evaluated ~~in lieu of the volume of the largest container~~.

FSAR Table 2.2-214, Design Basis Events, Flammable Vapor Clouds (Delayed Ignition) and Vapor Cloud Explosions will be revised as follows:

Source	Chemical Evaluated & Quantity	Distance to Nearest Safety-Related Structure	Distance to LFL	Safe Distance for Vapor Cloud Explosions	Thermal Radiation Heat Flux at Nearest Safety-Related Structure
Road: Onsite Transport	Gasoline (50,000 pounds)	2,054 feet	402 feet[(e)]	1,014 feet	2.776 kW/m^2
Pipeline: Turkey Point Lateral	Natural Gas	4,535 feet	750 feet[(a)]	3,033 feet[(a)]	0.261 kW/m^2
Onsite (Includes Units 1 through 5)	Acetylene (3,000 pounds)	4,300 feet	1,308 feet[(e)]	1,764 feet[(e)]	0.162 kW/m^2
	Ammonium Hydroxide (40,000 gal)	5,079 feet	354 feet[(c)(a)(h)]	963 feet[(c)(a)(h)]	0.900 kW/m^2
	Hydrazine (1,100 gal)	2,727 feet	42 feet[(a)]	No Detonation[(d)]	0.271 kW/m^2
	Hydrogen (~~45,000~~**58,000** scf)	3,966 feet	~~1,032~~**1,179** feet[(e)]	~~1,182~~**1,347** feet[(e)]	0.033 kW/m^2
	Propane (500 gal)	4,168 feet	738 feet[(f)]	1,416 feet[(a)]	0.090 kW/m^2
Onsite (Includes Units 6 & 7)	Hydrazine (800 gal) (35% solution)	~~218~~**176** feet	< 33 feet[(c)(i)]	No Detonation[(c)(d)(i)]	N/A
	Hydrogen Tube Bank (40,000 scf)	560 feet	507 feet[(c)(e)]	~~432~~**514** feet[~~(c)~~(e)(g)]	2.344 kW/m^2
	Methanol (25,000 gal)	5,581 feet	282 feet[(e)]	804 feet[(e)]	0.592 kW/m^2
	Morpholine (800 gal)	~~218~~**176** feet	< 33 feet[(a)(i)]	No Detonation[(c)(d)(i)]	N/A
Offsite (Homestead Air Force Base)	Gasoline (137,104 lb)	25,133 feet	678 feet[(e)]	1,623 feet[(e)]	0.051 kW/m^2
	Propane (185,865 lb)		2,190 feet[(a)]	4,866 feet[(e)]	0.078 kW/m^2

Footnote (g) of FSAR Table 2.2-214, Design Basis Events, Flammable Vapor Clouds (Delayed Ignition) and Vapor Cloud Explosions will be revised as follows:

(g) ~~For t~~**T**he vapor cloud explosion analysis**, in the case of hydrogen storage at Units 6 & 7, accounts for the buoyancy of a postulated release of gaseous hydrogen when traveling as the formed vapor cloud. Additionally, a TNT equivalency calculation (for spherical aerial vapor clouds) was used to determine the distance to 1 psi in this case.**~~the amount of hydrogen released is assumed to be 13,334 scf. It is assumed that a catastrophic accident could result such that one third of the tubes rupture and release their entire contents, which travel towards the nearest safety-related structure prior to detonation~~

ASSOCIATED ENCLOSURES:

None