From:	RILEY, Jim
To:	Miller, Ed; Cook, Christopher
Cc:	Abisamra, Joe; Attarian, George; Bell, Roderick; bolognar@firstenergycorp.com; Brunette, Pat; Buman, Dan; Burris, Ken ; Carrie L. Stokes (carrie.stokes@bwsc.net); Colin Keller; Dave Bucheit; Dean Hubbard (dmhubbard@duke-energy.com); "Faller, Carl"; Gambrill, David; GASPER, JOSEPH K; Giddens, John; Glen D Ohlemacher (ohlemacherg@dteenergy.com); Hackerott, Alan; Heather Smith Sawyer (heather.sawyer@bwsc.net); Heerman, John; Horstman, William R; "Huffman, Ken"; HYDE, KEVIN C; Jeff Brown (jeffrey.brown@aps.com); Jim Breunig (james.breunig@cengllc.com); Joe Bellini (joe.bellini@amec.com); John Lee (John.Lee@dom.com); Kit Ng (kyng@bechtel.com); LaBorde, Jamie; Larry Shorey (ShoreyLE@Inpo.org); Lorin.Young@CH2M.com; Maddox Jim (maddoxje@inpo.org); Mannai, David J; manolerasm@firstenergycorp.com; Matt Nienaber (mbniena@nppd.com); Maze, Scott; Michael Proctor (michael.proctor@urs.com); MICHAEL.J.MILLER@sargentlundy.com; Mike Annon - Home (ICENG2008@AOL.COM); Mike Annon (annonm@dteenergy.com); Miller, Andrew; Murray, Mike; Parker, Thomas M.; Ray Schneider (schneire@westinghouse.com); RILEY, Jim; Robinson, Mike; Rogers, James G; Rudy Gil; Scarola, Jim; Selman, Penny; Shumaker, Dennis; Snyder, Kirk; Stapleton, Dan; Stone, Jeff; Terry Grebel (tlg1@pge.com); Thayer, Jay ; Vinod Aggarwal (Vinod.aggarwal@exeloncorp.com); Wrobel, George; Yale, Bob
Subject:	Materials for October 24th Meeting
Date:	Tuesday, October 23, 2012 5:08:29 PM
Attachments:	Scenario-Example_R2A.docx 10-24-12 NRC - Ind Mtg on Flooding.pptx

Chris, Ed,

Our slides and a revised version of our example of a scenario based approach are attached. I will send you our dam failure evaluation white paper with responses to your comments separately.

Jim Riley
NEI
(o) 202-739-8137
(c) 202-439-2459
(f) 202-533-0193
jhr@nei.org

FOLLOW US ON

Draft WORKING EXAMPLE

Example with one and one half days to flood design barrier overtopping.

Initial Plant Condition: Power Operation

A plant has an external flood protection system that is based on a design basis flood of 900 ft. Following the hazard re-evaluation the external flood height was found to have increased to 905 ft. The results of this re-evaluated hazard height indicate that all design basis safety systems would be compromised by having barriers overtopped. The limiting event for this re-evaluated external flood height is a breach of an upstream dam. The anticipated time for the flood to reach the 900 ft elevation is 24 hours after the initial dam breach. A peak flood height of 9005 ft can potentially be reached 12 hours later. In anticipation of this challenge the plant installed two medium voltage diesel generators and a day tank filled with fuel in a protected area at an elevation of 910 ft. The DG can be operated from its storage location and the location meets the protection guidance of NEI 12-06. Among other loads,the DGs can be aligned to power one of two submersible pumps dedicated for external flood mitigation.

As a result of the location and elevation of the alternate facility, access to the DG would not be compromised in a flood. Availability of roads in the vicinity of the facility ensures that replenishment of fuel was highly likely in a timely fashion. Prior to site flooding contracts are in place to store an oil tanker truck on a dry area near the day tank as directed by procedure. Adequate supply is available in the day tank aligned with the installed medium voltage diesel generators to maintain continuous operation for one day. The tanker truck contains sufficient oil to refuel the DG tank for a period of five days. Hoses can be readily aligned to a tank refill line. Procedures are in place to refill the tank once the oil tank level reaches ½ of the tank level. The tank refill period is ½ hour. The oil consumption rate is such that 12 hours will be available to perform the action to refill the day tank.

An underground cable was installed from the DG to an installed submersible well pump located within a well on the site. In the well location the pump suction is not exposed to floating debris. Piping from the submersible pump can be aligned to a connection to a line feeding the steam generator via two manually operated valves. Any necessary spool pieces are connected and valves are directed by procedure to be open in advance of the flood reaching the site elevation. Check valves are provided to avoid reverse flow should the manual valves be opened with high steam generator pressure. The submersible pump is sized for decay heat removal at heat loads associated with six hours after shutdown. Water quality for the submersible pump is consistent with its intended flood mitigation function as water from a well is not impacted by the flood environment. The required pumping capability is well within the design flow capability.

Should the targeted submersible pump fail to start or run, the alternate pump can be readily aligned. As the two pumps are anticipated to be available for the event duration, run failures during the mission time can be accommodated by switching to the alternate pump. Both pumps are aligned to the suction source and discharge to the steam generator (SG) throughout the event. Back flow is prevented via check valves. To ensure reliable system operation, pumps have preventive maintenance and are tested periodically. Training in operation and repair of the DGs and other support components is performed once a year prior to spring flood season. It is this season where the flood scenario is most likely.

The motor control centers (MCCs) are located in the vicinity of the DGs and are dedicated to operation of the pumps. A single dedicated cable connecting the MCCs and pump is provided. Alternate cables between the DG facility and pump MCC can be installed on a temporary basis. This action may be completed in 6 hours. This represents approximately twice the time available to perform this function.

In addition to feed operations, the SG must be vented to allow low pressure injection from the portable pumps. This action must be taken via opening of ADVs and is an early required action in the external flood abnormal operating procedure. Actions to mechanically maintain the ADVs open are proceduralized and the necessary systems to perform this action are located in the vicinity of the ADVs. In the event ADVs cannot be actuated, provisions for one MSSV to be opened are established. These actions are also well proceduralized and will be taken well in advance of the time at which the flood could increase difficulty in accessing the associated equipment.

Formatted: Font color: Auto

As the limiting flood is a dam breach, the site has one day warning prior to the flood reaching 900 ft, and an additional 12 hours prior to reaching 905 ft. The US Corps of Engineers provides reasonably reliable flood level forecasting. Flood duration at 905 ft is estimated to be less than two weeks.

A review of Table A.1 indicates that all the functional, operational, unavailability and storage characteristics expectation of Table A.1 are met (See below)

Table 1 Comparison of System Capability to Table A.1 of Appendix A	
Functional characteristics	Flood Mitigation System is designed to standard engineering practices and documented analyses are available. Equipment is to be operated within manufacturer's specifications. Main components are redundant with the exception of the underground cable. A temporary independent means of connecting the DG to one of two submersible pump MCC is also available.
Operational Characteristics	All testing requirements are met. Visual surveillances are conducted quarterly. Functional tests are performed annually. All preventive maintenance will be performed with manufacturers specifications To minimize unavailability corrective maintenance will be performed consistent with maintenance rule practices for safety significant components. While no formal technical specification will be provided for this equipment unavailability will be limited to less than 30 days.
Unavailability Characteristics	Unavailability is to be limited to < 30 days A full complement of spare parts for the DG and submersible pumps and associated electrical and mechanical connectors will be maintained on site in a flood accessible area. Equipment is stored or placed in an operable configuration where it is protected from the flood environment.

The reliability of this key system /components is presented in Table 2: Reliability estimates are based on generic performance characteristics of typical commercial grade and well maintained equipment, where available.

Table 2: Reliability Evaluation of Key Systems / Components Credited in Flood Mitigation System Design			
Component	Failure Rate	Probability of Failure	Basis
Submersible portable pump failure to run	1x 10^{-4}/hour	0.034 (14 day operation)	Mean failure rate based on generic value estimated from operation of low pressure, low flow. Low pressure electric driven pumps. Considers data from IEEE,NPRDS and ORECA.
Submersible pump failure to start	0.001	0.001	Nominal failure to start is 0.02/d. Reduced value selected based on engineering judgement considering plant staff has more than one day to start pump and has adequate parts and staff on site to make necessary repairs if pump does not immediately start.
DG fail to run	5 x10^{-5}/hr	0.017 (14 day operation)	Mean failure rate based on generic failure values of medium voltage , medium power DG. Considers data from IEEE,NPRDS and ORECA.
DG fail to start	0.001	0.001	Mean failure to start based on engineering judgement. ~~generic data is 0.002/d.~~
Failure rate of Electrical cable or connectors	~~10^{-6}/hr~~--	~~0.003~~---	Unavailable~~System value based on generic values for components~~
Failure of Day Tank to Feed DG	0.001	0.001	Manual valve connection. Generic data

~~As can be seen from the above table, the failure rates for long term operation of the key heat removal components are low. Assuming no replacement capability the overall operational reliability of a single train of the mitigation system will be approximately 0.95 for 14 day operation.~~ Based on the above discussion the mitigation components are well maintained, operators are trained in their use, and adequate ~~Sufficient~~ redundancy exists in the system design such that the overall system reliability is high.

Human actions associated with the implementation of this mitigation strategy was also considered. Response to the event is governed by the site emergency plan and subsidiary procedures to direct specific maintenance, preparatory and operator actions. Overall processes are directed as follows:

1. US Corps of Engineers or national Weather service notifies site management of anticipated flood and arrival time. As a result of dam locations advance warning is at least 24 hours before the current design basis flood capabilities of the plant are challenged. If a hydrologic failure of an upstream dam is possible, additional warning will be occur as USACE follows their internal dam protection operational strategies. These actions will be taken prior to dam breach.
2. Once a potential flooding condition is identified the emergency response organization will be activated.
3. If the plant were operating at power, the plant will be placed in cold shutdown with heat removal via the steam generators [for steaming].
4. Procedure [TBD] will direct the plant to:
   - 4.1. Place flood protection features in place.
   - 4.2. Locate oil tank truck to designated location
   - 4.3. Prepare mitigation backup equipment for operation.
   - 4.4. Place mitigation equipment in the desired post flood alignment

This could be displayed as a timeline showing margins and parallel activities.

Human actions necessary for flood mitigation will be developed and validated following the guidance of NEI-10-05. In addition, all mitigation actions identified below will be consistent with the expectations of current industry guidance for emergency planning post-Fukushima as identified inNEI-12-01. This includes validation of key actions via time-in-motion studies for time critical actions.

Human actions to be taken have been evaluated with respect to Appendix C expectations. As all necessary actions following activation of the ERO are proceduralized, all Appendix C actions can be met at the nominal level of better. Note that cues for actions due to low SG level can be obtained via use of portable equipment temporary equipment. A comparison of the human action characteristics associated with the external flood mitigation activity and the Appendix C criteria are provided in Table 3.

Table 3: Summary of Key Human Actions for Implementing Credited Flood Mitigation Strategy		
Action	Description of Action	Appendix C Assessment
USACE informs Staff of dam break and procedures provide for ERO activation , staff mobilization and other preparation for flood.	Action is highly reliable. Appropriate procedures are in place for proper communication. Overall time estimate to initiate full mobilization is 8 hours from initial notification.	Not directly applicable
Fuel oil tanker truck staged on high ground with acess to DG facility.	Action is highly reliable. Appropriate procedures and contracts are in place for proper communication. Overall time estimate to initiate full mobilization is 8 hours from initial notification.	Not directly applicable
Operator Shuts down plant and places it in a Steam Generator a low pressure heat removal mode	Standard proceduralized action supplemented by flood procedures. Action takes [8] hours	Available time : Nominal Accessibility:Nominal Stress:Nominal Dignostic Complexity: Nominal Procedures:Nominal Staffing:Nominal Communications:Nominal HFE: Nominal
Operator installs necessary connecting spool pieces and aligns SG feed to flood protected source	Simple proceduralized action. Action can be performed by a single operator in a period of 1 hour. Action can be implemented once reactor is shutdown for more than 6 hours. Available time to perform action is 6 hours. Six hours assumes operator has to leave area prior to barrier overtopping (4 hours allotted).	Available time : Extra Accessibility:Nominal Stress:Nominal Dignostic Complexity: Obvious Procedures:Nominal Staffing:Nominal Communications:Nominal HFE: Nominal
Operator opens ADV and takes actions to provide continuous low pressure operation	Proceduralized action. Mechanical device can be installed in 4 hours. Access to staging areas not impacted by flood.	Available time : Nominal Accessibility:Nominal Stress:Nominal Dignostic Complexity: Obvious Procedures:Nominal Staffing:Nominal Communications:Nominal HFE: Nominal
Operator opens fuel feed to feed DG	Simple proceduralized action. Can be performed in parallel with SG	Available time : Extra Accessibility:Nominal

Table 3:

Summary of Key Human Actions for Implementing Credited Flood Mitigation Strategy

Action	Description of Action	Appendix C Assessment
	alignment actions. Operator must be dispatched to DG area. Action takes 1 hour including preparing the DG for operation.	Stress:Nominal Dignostic Complexity: Obvious Procedures:Nominal Staffing:Nominal Communications:Nominal HFE: Nominal
Operator refills day tank.	Action to refuel day tank. Must be done prior to emptying of day tank to avoid priming of the DG fuel system. Action must be taken once a day with more than 12 hours available time. Time to refill tank is 30 minutes.	Available time : Extra Accessibility:Nominal Stress:Nominal Dignostic Complexity: Obvious Procedures:Nominal Staffing:Nominal Communications:Nominal HFE: Nominal
Additional resources added to site after 3 days	Plant management directs off site contracted resources to deliver resources to day tank area and resources are delivered at least one day before need arises	Available time : Nominal Accessibility:Nominal Stress:Nominal (roads open and not flooded along route) Dignostic Complexity: Nominal Procedures:Contracts in place and plans pre-established Staffing:Nominal Communications:Nominal HFE: Nominal

Conclusion

As a consequence of the low failure probabilities of flood protected equipment and high reliability of the necessary human actions being taken to implement the external flood mitigation procedures described above, , there is adequate assurance that the site will be protected from an overtopping of the design flood barrier during the re-evaluated hazard.

NRC – FFTF Meeting
NEI FFTF Input

October 24, 2012

NEI

Elements of a Scenario Based Evaluation

- Description of scenario and key components
- Discussion of mitigation actions
- Timeline showing necessary components and operator actions
  - Showing parallel and series activities
  - Laid out against available time
- Evaluate components against Appendix A
- Document component reliability when available
- Evaluate actions against Appendix C
- Conclude overall reliability of mitigation strategy

Storm Surge ISG

- ISG is not very clear regarding what conditions require a storm surge evaluation
  - Historical precedent / engineering judgment?
  - Further clarification or examples would help
- Alternative approach to storm surge is complex and time consuming and may not be usable within the time frame allowed for response to the 50.54(f) letter
- No discussion of combined events (e.g., riverine)

NEI

Storm Surge ISG

- Is the "uncertainty" discussed at the end of section 3.1 a statistical uncertainty or uncertainty demonstrated by variation of input parameters
- Bounding surge elevation based on varying PMH size - NWS 23 is supposed to capture a range of values based on meteorological possibilities; why go beyond the values in this document (last paragraph in section 3.2.1.1)

NEI

Storm Surge ISG

- Is there any guidance for determining the effects of debris and water borne projectiles (section 5.6)? Is this different from the approach used for new plants?

Tsunami ISG

- Can tsunamis be screened out by engineering judgment for inland sites?

NEI