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July 1, 1981

Mr. Steve Ramos
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U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Steve:

Enclosed is PNL's review of the Pilgrim Nuclear Station EAL's found in Annex J of their Emergency Plan dated April 1, 1981.

If we can be of further assistance, please do not hesitate to call.

Sincerely,

A. E. Desrosiers
Senior Research Scientist
Health Physics Technology Section

AED/lml

cc: D. W. Faletti

bcc: PL Cummings
TH Essig
JM Selby

Date June 30, 1981

To A. E. Desrosiers

From D. W. Faletti D. W. Faletti

Subject Pilgrim Nuclear Station EALs

I have reviewed the Pilgrim Nuclear Station EALs found in Annex J of their Emergency Plan of April 1, 1981. Modifications and additions to the EALs are required before they can be considered acceptable. Many initiating conditions are not addressed at all. In many cases where they are addressed, the EALs do not identify the instrumentation that would be used. The licensee should refer to PNL-3880 for guidance.

My comments are presented below. For convenience, the initiating conditions are given in Attachment A.

UNUSUAL EVENT

Initiating Conditions No. 1, 12, 13b, 14b, 14e, and 15 were not addressed.

The EALs for Initiating Conditions 5, 6, and 7 should be supported by instrument readings.

The EALs for Initiating Condition 2 (Radiological effluent technical specification limits exceeded) are deficient because liquid effluents are not addressed.

An EALs for exceeding the allowed rate of temperature change of the reactor coolant and an EAL for abnormal fuel temperatures should be added to the EALs for Initiating Condition 4.

The EALs for Initiating Condition No. 7 are deficient because loss of onsite AC power is not covered.

The applicable paragraphs in the technical specifications should be listed for Initiating Conditions 8 and 9.

The EAL for Initiating Condition 10 (Fire) is deficient in that it calls for a 10-minute delay of notification after fire-fighting efforts have begun. This delay should be eliminated.

The EALs for Initiating Condition 13 (Earthquake) are deficient in that observed damage must occur before notification. Observation of an earthquake is all that is required.

The EAL for Initiating Condition 16 is acceptable since it is conservative. However it need not include internally contaminated individuals as currently there are no restrictions on such people leaving a nuclear site.

ALERT EMERGENCY

Initiating Conditions 4, 9, 10, 12, 17b, 17c, 18b, 18c, 18e, 19, and 20 were not addressed.

Instrumentation readings should be provided for Initiating Conditions 5, 6, 7, 8, and 11.

Initiating Condition 15 (Radioactive effluents in excess of ten times technical specifications) should include liquid effluents as well as airborne effluents.

SITE EMERGENCY

EALs were not prepared for Site Emergency Initiating Conditions 1, 2, 7, 12, 14, 15a, 15b, 15c, 16a, 16b, 16c, and 18.

Initiating Condition 4 (Steam line break outside containment without isolation) is addressed, but no instrument readings are provided.

GENERAL EMERGENCY

General Emergency 4 and 7 were not addressed. EALs should be provided for these.

General Emergency 1 (Radiation release). Delete the word "sustained" from Pilgrim EAL number 1.

General Emergency 2 (Two of three fission product barriers lost with a potential for loss of third barrier). This is Pilgrim's EAL set number 2 under General Emergency. The following comments apply:

- EALs for potential loss of the third barrier should be provided as per PNL-3880.
- an EAL "Gap Activity in Containment" should be provided as indicating occurrence of both 2a and 2b (loss of cladding and loss of reactor coolant boundary)
- under paragraph 2a consider adding "core uncovered for over ten minutes" as an EAL
- an EAL "Failure of MSIVs to isolate" should be provided as indicating occurrence of 2b and 2c (loss of reactor coolant boundary and loss of primary containment)
- under EAL 2.b.2 which reads "Drywell pressure greater than 10 psig and increasing" delete the "and increasing". See discussion in PNL-3880, p. 132, second paragraph.

General Emergency 3 (Loss of Physical Control of the Facility). This is Pilgrim's EAL number 3. "Loss of physical control of the main control room" is not broad enough. This EAL should read "Physical attack on the plant has resulted in unauthorized personnel occupying the control room or any other vital areas as described in the modified amended security plan."

General Emergency 6. Pilgrim provided EALs for this initiating condition under their EALs 4 and 5. The EALs given are a good general criteria but should be supplemented by instrument readings per PNL-3880.

DWF:pas

EXAMPLE INITIATING CONDITIONS: NOTIFICATION OF UNUSUAL EVENT

1. Emergency Core Cooling System (ECCS) initiated and discharge to vessel

2. Radiological effluent technical specification limits exceeded

3. Fuel damage indication. Examples:

   a. High offgas at BWR air ejector monitor (greater than 500,000 uci/sec; corresponding to 16 isotopes decayed to 30 minutes; or an increase of 100,000 uci/sec within a 30 minute time period)

   b. High coolant activity sample (e.g., exceeding coolant technical specifications for iodine spike)

   c. Failed fuel monitor (PWR) indicates increase greater than 0.1% equivalent fuel failures within 30 minutes

4. Abnormal coolant temperature and/or pressure or abnormal fuel temperatures outside of technical specification limits

5. Exceeding either primary/secondary leak rate technical specification or primary system leak rate technical specification

6. Failure of a safety or relief valve in a safety related system to close following reduction of applicable pressure

7. Loss of offsite power or loss of onsite AC power capability

8. Loss of containment integrity requiring shutdown by technical specifications

9. Loss of engineered safety feature or fire protection system function requiring shutdown by technical specifications (e.g., because of malfunction, personnel error or procedural inadequacy)

10. Fire within the plant lasting more than 10 minutes

11. Indications or alarms on process or effluent parameters not functional in control room to an extent requiring plant shutdown or other significant loss of assessment or communication capability (e.g., plant computer, Safety Parameter Display System, all meteorological instrumentation)

12. Security threat or attempted entry or attempted sabotage

13. Natural phenomenon being experienced or projected beyond usual levels

    a. Any earthquake felt in-plant or detected on station seismic instrumentation

    b. 50 year floor or low water, tsunami, hurricane surge, seiche

    c. Any tornado on site

    d. Any hurricane

14. Other hazards being experienced or projected

    a. Aircraft crash on-site or unusual aircraft activity over facility

    b. Train derailment on-site

    c. Near or onsite explosion

    d. Near or onsite toxic or flammable gas release

    e. Turbine rotating component failure causing rapid plant shutdown

15. Other plant conditions exist that warrant increased awareness on the part of a plant operating staff or State and/or local offsite authorities or requir plant shutdown under technical specification requirements or involve other than normal controlled shutdown (e.g., cooldown rate exceeding technical specification limits, pipe cracking found during operation)

16. Transportation of contaminated injured individual from site to offsite hospital

17. Rapid depressurization of PWR secondary side.

EXAMPLE INITIATING CONDITIONS: ALERT

1. Severe loss of fuel cladding

   a. High offgas at BWR air ejector monitor (greater than 5 ci/sec; corresponding to 16 isotopes decayed 30 minutes)

   b. Very high coolant activity sample (e.g., 300 uci/cc equivalent of I-131)

   c. Failed fuel monitor (PWR) indicates increase greater than 1% fuel failures within 30 minutes or 5% total fuel failures.

2. Rapid gross failure of one steam generator tube with loss of offsite power

3. Rapid failure of steam generator tubes (e.g., several hundred gpm primary to secondary leak rate)

4. Steam line break with significant (e.g., greater than 10 gpm) primary to secondary leak rate (PWR) or MSIV malfunction causing leakage (BWR)

5. Primary coolant leak rate greater than 50 gpm

6. Radiation levels or airborne contamination which indicate a severe degradation in the control of radioactive materials (e.g., increase of factor of 1000 in direct radiation readings within facility)

7. Loss of offsite power and loss of all onsite AC power (see Site Area Emergency for extended loss)

8. Loss of all onsite DC power (See Site Area Emergency for extended loss)

9. Coolant pump seizure leading to fuel failure

10. Complete loss of any function needed for plant cold shutdown

11. Failure of the reactor protection system to initiate and complete a scram which brings the reactor subcritical

12. Fuel damage accident with release of radioactivity to containment or fuel handling building

13. Fire potentially affecting safety systems

14. Most or all alarms (annunciators) lost

15. Radiological effluents greater than 10 times technical specification instantaneous limits (an instantaneous rate which, if continued over 2 hours, would result in about 1 mr at the site boundary under average meteorological conditions)

16. Ongoing security compromise

17. Severe natural phenomena being experienced or projected

    a. Earthquake greater than OBE levels

    b. Flood, low water, tsunami, hurricane surge, seiche near design levels

    c. Any tornado striking facility

    d. Hurricane winds near design basis level

18. Other hazards being experienced or projected

    a. Aircraft crash on facility

    b. Missile impacts from whatever source on facility

    c. Known explosion damage to facility affecting plant operation

    d. Entry into facility environs of uncontrolled toxic or flammable gases

    e. Turbine failure causing casing penetration

19. Other plant conditions exist that warrant precautionary activation of technical support center and placing near-site Emergency Operations Facility and other key emergency personnel on standby

20. Evacuation of control room anticipated or required with control of shutdown systems established from local stations

EXAMPLE INITIATING CONDITIONS: SITE AREA EMERGENCY

1. Known loss of coolant accident greater than makeup pump capacity

2. Degraded core with possible loss of coolable geometry (indicators should include instrumentation to detect inadequate core cooling, coolant activity and/or containment radioactivity levels)

3. Rapid failure of steam generator tubes (several hundred gpm leakage) with loss of offsite power

4. BWR steam line break outside containment without isolation

5. PWR steam line break with greater than 50 gpm primary to secondary leakage and indication of fuel damage

6. Loss of offsite power and loss of onsite AC power for more than 15 minutes

7. Loss of all vital onsite DC power for more than 15 minutes

8. Complete loss of any function needed for plant hot shutdown

9. Transient requiring operation of shutdown systems with failure to scram (continued power generation but no core damage immediately evident)

10. Major damage to spent fuel in containment or fuel handling building (e.g., large object damages fuel or water loss below fuel level)

11. Fire compromising the functions of safety systems

12. Most or all alarms (annunciators) lost and plant transient initiated or in progress

13. a. Effluent monitors detect levels corresponding to greater than 50 mr/hr for 1/2 hour or greater than 500 mr/hr W.B. for two minutes (or five times these levels to the thyroid) at the site boundary for adverse meteorology

    b. These dose rates are projected based on other plant parameters (e.g., radiation level in containment with leak rate appropriate for existing containment pressure) or are measured in the environs

    c. EPA Protective Action Guidelines are projected to be exceeded outside the site boundary

14. Imminent loss of physical control of the plant

15. Severe natural phenomena being experienced or projected with plant not in cold shutdown

    a. Earthquake greater than SSE levels

b. Flood, low water, tsunami, hurricane surge, seiche greater than design levels or failure of protection of vital equipment at lower levels

c. Sustained winds or tornadoes in excess of design levels

16. Other hazards being experienced or projected with plant not in cold shutdown

a. Aircraft crash affecting vital structures by impact or fire

b. Severe damage to safe shutdown equipment from missiles or explosion

c. Entry of uncontrolled flammable gases into vital areas. Entry of uncontrolled toxic gases into vital areas where lack of access to the area constitutes a safety problem

17. Other plant conditions exist that warrant activation of emergency centers and monitoring teams or a precautionary notification to the public near the site

18. Evacuation of control room and control of shutdown systems not established from local stations in 15 minutes

EXAMPLE INITIATING CONDITIONS: GENERAL EMERGENCY

1. a. Effluent monitors detect levels corresponding to 1 rem/hr W.B. or 5 rem/hr thyroid at the site boundary under actual meteorological conditions

   b. These dose rates are projected based on other plant parameters (e.g., radiation levels in containment with leak rate appropriate for existing containment pressure with some confirmation from effluent monitors) or are measured in the environs

   Note: Consider evacuation only within about 2 miles of the site boundary unless these site boundary levels are exceeded by a factor of 10 or projected to continue for 10 hours or EPA Protective Action Guideline exposure levels are predicted to be exceeded at longer distances

2. Loss of 2 of 3 fission product barriers with a potential loss of 3rd barrier, (e.g., loss of primary coolant boundary, clad failure, and high potential for loss of containment)

3. Loss of physical control of the facility

   Note: Consider 2 mile precautionary evacuation

4. Other plant conditions exist, from whatever source, that make release of large amounts of radioactivity in a short time period possible, e.g., any core melt situation. See the specific PWR and BWR sequences below.

   Notes: a. For core melt sequences where significant releases from containment are not yet taking place and large amounts of fission products are not yet in the containment atmosphere, consider 2 mile precautionary evacuation. Consider 5 mile downwind evacuation (45° to 90° sector) if large amounts of fission products (greater than gap activity) are in the containment atmosphere. Recommend sheltering in other parts of the plume exposure Emergency Planning Zone under this circumstance.

   b. For core melt sequences where significant releases from containment are not yet taking place and containment failure leading to a direct atmospheric release is likely in the sequence but not imminent and large amounts of fission products in addition to noble gases are in the containment atmosphere, consider precautionary evacuation to 5 miles and 10 mile downwind evacuation (45° to 90° sector).

   c. For core melt sequences where large amounts of fission products other than noble gases are in the containment atmosphere and containment failure is judged imminent, recommend shelter for those areas where evacuation cannot be completed before transport of activity to that location.

d. As release information becomes available adjust these actions in accordance with dose projections, time available to evacuate and estimated evacuation times given current conditions.

5. Example PWR Sequences

a. Small and large LOCA's with failure of ECCS to perform leading to severe core degradation or melt in from minutes to hours. Ultimate failure of containment likely for melt sequences. (Several hours likely to be available to complete protective actions unless containment is not isolated)

b. Transient initiated by loss of feedwater and condensate systems (principal heat removal system) followed by failure of emergency feedwater system for extended period. Core melting possible in several hours. Ultimate failure of containment likely if core melts.

c. Transient requiring operation of shutdown systems with failure to scram which results in core damage or additional failure of core cooling and makeup systems (which could lead to core melt)

d. Failure of offsite and onsite power along with total loss of emergency feedwater makeup capability for several hours. Would lead to eventual core melt and likely failure of containment.

e. Small LOCA and initially successful ECCS. Subsequent failure of containment heat removal systems over several hours could lead to core melt and likely failure of containment.

NOTE: Most likely containment failure mode is melt-through with release of gases only for dry containment; quicker and larger releases likely for ice condenser containment for melt sequences. Quicker releases expected for failure of containment isolation system for any PWR.

6. Example BWR Sequences

a. Transient (e.g., loss of offsite power) plus failure of requisite core shut down systems (e.g., scram). Could lead to core melt in several hours with containment failure likely. More severe consequences if pumps trip does not function.

b. Small or large LOCA's with failure of ECCS to perform leading to core melt degradation or melt in minutes to hours. Loss of containment integrity may be imminent.

c. Small or large LOCA occurs and containment performance is unsuccessful affecting longer term success of the ECCS. Could lead to core degradation or melt in several hours without containment boundary.

d. Shutdown occurs but requisite decay heat removal systems (e.g., RHR) or non-safety systems heat removal means are rendered unavailable. Core degradation or melt could occur in about ten hours with subsequent containment failure.

7. Any major internal or external events (e.g., fires, earthquakes, substantially beyond design basis) which could cause massive common damage to plant systems resulting in any of the above.