(14)

JAN 0 6 1984

MEMORANDUM FOR: Assistant Directors for DSI, DST, DE, DL & DHFS

FROM: R. Wayne Houston, Assistant Director for Reactor Safety, DSI

SUBJECT: REVIEW OF GESSAR-II DESIGN IMPROVEMENT

Reference: Houston, R. W., to Assistant Directors, "Review of GESSAR-II Design Improvement," August 1, 1983.

The referenced memo (Attachment 2) requested your participation in the development of a list of potential design improvements for the GESSAR-II design. The list will be used by the staff to ensure that the CP/ML Rule, 10 CFR 50.34(f) (1), is met, specifically in regard to seeking "improvements in the reliability of core and containment heat removal systems as are significant and practical and do not impact excessively on the plant."

Attachment 1 is a summary of the information that was received in response to the memo. Staff members of DSI and DST have attempted to edit the information to focus concepts and reduce ambiguity, and we would like to continue this process where possible. Accordingly, I would appreciate your staff's efforts in reviewing the current list to identify any final revisions before we ask DL to set up a meeting to discuss the list with GE. You will note that each item on the list has been tentatively classified as being representative of either a "prevention" fix, a "mitigation" fix, or both.

I would also appreciate your comments on the process that we propose be used to solicit GE's response to the final list and to the associated section of the CP/ML Rule. We currently intend to require that GE provide a formal response in accordance with the following guidelines:

(1) GE should discuss each item on the list and provide a qualitative assessment of the relative merits and detriments. Any additional design improvements not presently on the list that have been considered by GE should be added and discussed.

(2) In addition, GE should perform a quantitative ranking of each item in terms of its potential relative impact on overall plant risk. An example of an acceptable ranking method is the one described in

NUREG/CR-3385, "Measures of Risk Importance and their Applications", July 1983. NUREG/CR-3385 describes analytical approaches to quantifying two measures of system value that are useful for (a) prioritizing plant improvements that can most effectively reduce risk, and (b) prioritizing plant improvements that are important in reliability assurance and maintenance activities. The measures are called "risk reduction worth" and "risk achievement worth" respectively. Other approaches for ranking may be acceptable. GE's use of alternate methods should be discussed with the staff.

(3) Based on the above, GE should identify promising means of risk reduction and perform preliminary cost estimates for a selected set of improvement schemes based on discussions with the staff.

(4) Following further discussions with the staff, GE would then be required to perform detailed risk, incremental risk, and cost benefit analyses for a selected subset of potential design improvements.

Please refer any questions to Brad Hardin (X28507) and provide any comments by January 23, 1984.

Original signed by
R. Wayne Houston

R. Wayne Houston, Assistant Director
for Reactor Safety, DSI

cc: R. Mattson
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ATTACHMENT 1

POTENTIAL DESIGN IMPROVEMENTS FOR GESSAR-II

1. Accident Management/Human Factors Considerations (M) (1)
   a. use of advanced instrumentation important to accident management including improved transient indicators, control room data acquisition and display and alarm prioritization,
   b. computer aided artificial intelligence including attention to risk issues in man-machine interfaces,
   c. improvements in maintenance procedures and manuals for GE scope of supply,
   d. extension of emergency procedure guidelines to cover severe accidents,
   e. use of simulators for operator training for severe accidents.

2. Augmented Reactor Decay Heat Removal (P&M)
   a. improved reliability of decay heat removal at operating pressure (HPCI, RCIC),
   b. addition of active decay heat removal system capable of operating at system pressure,
   c. addition of passive decay heat removal system (such as an isolation condenser) capable of operating at system pressure,
   d. improved reliability of depressurization system,
   e. items a, b, c designed for low pressure,
   f. installation of a dedicated suppression pool heat removal system.

3. Increased Containment Capability Margins (M)
   a. increased volume (2),
   b. increased pressure capability (e.g., increased to 25 psi or higher from 15 psi) (2),
   c. improved pressure suppression reliability,
   d. increased temperature margin (improved penetration seals, etc.),
   e. improved vacuum breaker design.

4. Augmented Containment Heat Removal (P&M)
   a. active and passive systems (including assessment of enhanced suppression pool cooling vs. higher capacity heat sink-perhaps 30% full power capacity for ATWS),
   b. passive ultimate heat sink.

5. Containment Atmosphere Mass Removal (M)
   a. filtered and unfiltered vent systems,
   b. low flow and high flow vent systems.

NOTES:
(1) P denotes a system capability improvement that is mainly preventive. M denotes an improvement that is mainly mitigative.
(2) For Item 3a and 3b, sensitivity assessments of risk vs. volume and pressure would be useful.

6. Combustible Gas Control Systems (M)
   a. inerting including consideration of preinerting, postinerting, and preconditioning,
   b. hydrogen igniters,
   c. use of existing or enhanced fire suppression systems.

7. BWR Containment Spray Systems (P&M)
   - including consideration for: capacity, initiation, water source, AC/DC dependencies, installation of a dedicated system, and ability to connect to a fire truck.

8. Specific Prevention Concepts (P)
   a. improved valve or drain design (e.g., SRVs, MSIVs, ECCS equipment room drains, rad waste system drains),
   b. improved control logic and component design to provide reliable operation over the full operational range (e.g., feedwater controls and RHR systems).
   c. reduction of common cause dependencies:
      - pump cooling and ventilation,
      - service water dependencies,
      - air supply dependencies,
      - other support systems,
      - relocation of equipment to improve separation and protection,
      - diversity of manufacturer of redundant equipment (e.g., LPCI pumps).
   d. modification or alternate selection of equipment based on operating experience (e.g., replacement of 3 stage Target Rock safety relief valves with 2 stage).

9. Improved AC Power Supplies (P)
   a. more and/or improved diesel generators and electrical divisions,
   b. uninterruptible power supply providing backup power to equipment critical to safe shutdown,
   c. bus crosstie advantages/disadvantages
   d. diverse motive sources (e.g., gas turbine).

10 Improved DC power Supplies (P&M)
   a. higher capacity batteries,
   b. additional batteries and electrical divisions,
   c. diverse DC power systems (e.g., fuel cells),
   d. bus crosstie advantages/disadvantages.

11. Improved Capability for ATWS (P)
   a. diverse electric scram,
   b. improved CRD hydraulic system including scram discharge volume,
   c. additional standby liquid control system pumps or other SBLC system improvements.

12. Improved Seismic Capability (P)
    a. integral basemat,
    b. increased design margin for those systems and components whose failure is shown to contribute significantly to seismic related risk.

13. System Simplification (P)
    a. elimination of unnecessary interlocks and auto initiation systems,
    b. elimination of certain redundant valves and components that are shown to have a negative effect on overall plant safety,
    c. elimination of seismic and pipe whip restraints.

14. Core Retention Devices (M)
    - including consideration of specific concrete types (limestone vs. basaltic) in the current cavity,
    - including a consideration of modification of the cavity geometry (access ports, floor slope, addition of corium flow diverters, etc.) to accomplish:
        a. equipment protection (e.g., electrical penetrations),
        b. retention of corium within the cavity region,
        c. dispersal of the corium outside the cavity including diversion to the suppression pool.

(4) (15)

MAR 07 1984

Docket No.: 50-447

MEMORANDUM FOR: Frank J. Miraglia, Assistant Director
for Safety Assessment
Division of Licensing

FROM: R. Wayne Houston, Assistant Director
for Reactor Safety
Division of Systems Integration

SUBJECT: REVIEW OF GESSAR-II DESIGN IMPROVEMENT

References:
1. Houston, R. W., to Assistant Directors, "Review of GESSAR-II Design Improvement," August, 1983.
2. Houston, R. W,. to Assistant Directors, "Review of GESSAR-II Design Improvement," January 6, 1984.

The staff's review of the GESSAR-II PRA is progressing, and it is planned to write an SER on this subject during this summer.

In addition to this review, and as required by the CP/ML Rule (10 CFR 50.34(f)(1)), the staff intends to assess the degree to which GE has considered potential "improvements in the reliability of core and containment heat removal systems as are significant and practical and do not impact excessively on the plant." To aid in this assessment, the staff has prepared the list of potential improvements included as Attachment 1. The attached list and the proposed plan for obtaining and documenting GE's evaluation of potential design improvements was developed jointly by RSB of DSI and RRAB of DST with comments solicited from DSI, DST, DE, DL and DHFS.

Attachment 2 includes the resulting proposed plan for obtaining the information needed by the staff to evaluate GE's assessment of potential design improvements.

I wish to clarify our objectives in performing this evaluation. In addition to carrying out the mandate of the Rule as stated in 10 CFR 50.34 to consider potential design improvements for standard plants, the documentation of this evaluation is very important in itself. Some of the items included on the attached list may not be expected to be

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X28507

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attractive today from a cost/benefit viewpoint considering the state of present day technology and understanding of severe accidents, however, it is important to benchmark our reasons for rejecting or downgrading certain potential improvements to: 1) allow for an appropriate peer review, 2) focus our attention on improvements that hold promise for substantial and cost effective reduction with today's technology, and 3) identify areas that appear to have substantial promise for future plants.

We interpret the Rule to include the consideration of design improvements other than plant systems hardware changes. Past PRA results indicate improvements in the human factors area could provide significant risk reductions, and so these types of improvements are included in the list.

Please send the list (Attachment 1) and the request for information (Attachment 2) to GE. We will need to meet with GE in the near future to discuss this subject and to establish a schedule for GE's response to the information request provided outlined in Attachment 2 that is compatible with the overall GESSAR-II PRA review schedule.

Please refer any questions to Brad Hardin (X28597).

Original signed by:

R. Wayne Houston, Assistant Director
for Reactor Safety
Division of Systems Integration

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BHardin:jf	WHodges	BSheron	RWHouston
2/ /84	2/ /84	2/ /84	2/ /84

ATTACHMENT 1

POTENTIAL DESIGN IMPROVEMENTS FOR GESSAR-II

1. Accident Management/Human Factors Considerations (M) (1)
   a. use of advanced instrumentation important to accident management including improved transient indicators, control room data acquisition and display and alarm prioritization (e.g., computer aided),
   b. computer aided artificial intelligence including attention to risk issues in man-machine interfaces,
   c. improvements in maintenance procedures and manuals for GE scope of supply,
   d. incorporation of plant design features to improve maintainability and the incorporation of a "designed" preventive maintenance program,
   e. extention of emergency procedure guidelines to cover severe accidents,
   f. coordination of design of remote shutdown capability with control room design and habitability and with other design interfaces (e.g., fire protection) considering human factors engineering,
   g. consideration in the design of the safeguards (security) system of the safety-safeguards interface with respect to access of operators in emergency conditions (e.g., fires, shutdown capability outside the control room, etc.),
   h. use of simulators for operator training for severe accidents.

2. Augmented Reactor Decay Heat Removal (P&M)
   a. improved reliability of decay heat removal at operating pressure (HPCI, RCIC),
   b. addition of active decay heat removal system capable of operating at system pressure (see Items 9e and 10e also),
   c. addition of passive decay heat removal system (such as an isolation condenser) capable of operating at system pressure,
   d. improved reliability of depressurization system,
   e. items a, b, c designed for low pressure,
   f. installation of a dedicated suppression pool heat removal system.
   g. enhanced jockey pump system for alternative heat removal

NOTES:

(1) P denotes a system capability improvement that is mainly preventive. M denotes an improvement that is mainly mitigative.

(2) For Item 2a and 2b, sensitivity assessments of risk vs. volume and pressure would be useful.

(3) Regarding Item No. 6, the specific requirements in the CP/ML Rule (10CFR50.34(f)) dealing with hydrogen control were [illegible] so as not to foreclose [illegible] adoption of any new requirements that might be developed from further work on severe accidents. If, upon completion of the further work on severe accidents, some of the requirements in the CP/ML Rule are made moot, proposed exemptions from these requirements [illegible] be entertained by the [illegible].

e. safety related Condensate Storage Tank (protected from natural phenomena) with capability for a 16 hr. station blackout,
f. provision for removal of decay heat during a 16 hr. station blackout via direct steam condensation to either the RHR heat exchanger or another heat sink other than the suppression pool.

3. Increased Containment Capability Margins (M)
   a. increased volume (2),
   b. increased pressure capability (e.g., increased to 25 psi or higher from 15 psi)(2),
   c. improved pressure suppression reliability,
   d. increased temperature margin (improved penetration seals, etc.),
   e. improved vacuum breaker design.

4. Augmented Containment Heat Removal (P&M)
   a. active and passive systems (including assessment of enhanced suppression pool cooling vs. higher capacity heat sink-perhaps 30% full power capacity for ATWS),
   b. passive ultimate heat sink.

5. Containment Atmosphere Mass Removal (M)
   a. filtered and unfiltered vent systems,
   b. low flow and high flow vent systems.

6. Combustible Gas Control Systems (M)(3)
   a. inerting including consideration of preinerting, post inerting and preconditioning,
   b. hydrogen igniters,
   c. use of existing or enhanced fire suppression systems.

7. BWR Containment Spray Systems (P&M)
   - including consideration for: capacity, initiation, additives water source, AC/DC dependencies, installation of a dedicated system, and ability to connect to a backup water supply (e.g., a fire truck or a jockey pump system).

8. Specific Prevention Concepts (P)
   a. improved valve or drain design (e.g., SRVs, MSIVs (including orientation effects), ECCS equipment room drains, rad waste system drains),
   b. improved control logic and component design to provide reliable operation over the full operational range (e.g., feedwater controls and RHR systems),
   c. reduction of common cause dependencies:
      - pump cooling and ventilation,
      - service water dependencies,
      - air supply to valves,
      - other support systems,
      - relocation of equipment to improve separation and protection,
      - diversity of manufacturer of redundant equipment (e.g., LPCI pumps),
      - modification or alternate methods of [illegible]

Target Rock safety relief valves with 2 stage as has occurred in earlier BWR designs),

e. consideration of water hammer (USI A-1) in current design per ongoing SRP revisions (i.e., use of void detection and venting design features and potential for water hammer with degraded piping),

f. consideration of degraded ECCS pump performance (USI A-43) in accordance with R.G. 1.82, Rev. 1 when issued,

g. provision of sufficient instrument air to operate valves and necessary air operated instrumentation and controls during a 16 hr. station blackout,

h. provision of sufficient ventilation and cooling to ensure operation of essential equipment and controls during a 16 hr. station blackout,

i. assurance of recirculation pump seal integrity during a 16 hr. station blackout.

j. alternate power source for feedwater pumps (e.g., gas turbine)

9. Improved AC Power Supplies (P)

a. more and/or improved diesel generators and electrical divisions,

b. uninterruptible power supply providing backup power to equipment critical to safe shutdown,

c. optimization of the configuration of the onsite safety-related distribution system from a reliability viewpoint including the effects of bus crossties,

d. diverse motive sources (e.g., gas turbine).

e. dedicated onsite power supplies to dedicated (bunkered) decay heat removal systems.

10 Improved DC power Supplies (P&M)

a. higher capacity batteries,

b. additional batteries and electrical divisions,

c. diverse DC power systems (e.g., fuel cells),

d. optimization of the configuration of the onsite safety-related distribution system from a reliability viewpoint including the effects of bus crossties,

e. dedicated, diverse onsite power supplies to dedicated (bunkered) decay heat removal systems.

f. diverse motive sources (e.g., steam driven turbine generator)

11. Improved Capability for ATWS (P)

a. diverse electric scram,

b. improved CRD hydraulic system including scram discharge volume,

c. additional standby liquid control system pumps or other SLC system improvements.

12. Improved Seismic Capability (P)

a. internal basemat,

b. [illegible] design margin for those systems and structures whose failure is known to contribute significantly to reactor [illegible]

13. System Simplification (P)
    a. elimination of unnecessary interlocks and auto initiation systems,
    b. elimination of certain redundant valves and components that are shown to have a negative effect on overall plant safety,
    c. elimination of seismic and pipe whip restraints.

14. Core Retention Devices (M)
    - including consideration of specific concrete types (limestone vs. basaltic) in the current cavity,
    - including a consideration of modification of the cavity geometry (access ports, floor slope, addition of corium flow diverters, etc.) to accomplish:
        a. equipment protection (e.g., electrical penetrations),
        b. retention of corium within the cavity region,
        c. dispersal of the corium outside the cavity including diversion to the suppression pool.

ATTACHMENT 2

REVIEW OF GESSAR-II DESIGN IMPROVEMENTS

The enclosed list of potential design improvements has been prepared to aid in initiating an assessment of potential design improvements in compliance with the CP/ML Rule (10CFR50.34(f)).

To allow the staff to complete its evaluation in this area, the following information is required:

(1) GE should discuss each item on the list and provide a qualitative assessment of the relative merits and detriments. Any additional design improvements not presently on the list that have been considered by GE should be added and discussed.

(2) In addition, GE should perform a quantitative ranking of each item in terms of its potential relative impact on overall plant risk. An example of an acceptable ranking method is the one described in NUREG/CR-3385, "Measures of Risk Importance and their Applications", July 1983. NUREG/CR-3385 describes analytical approaches to quantifying two measures of system value that are useful for (a) risk, and (b) prioritizing plant improvements that are important in reliability assurance and maintenance activities. The measures are called "risk reduction worth" and "risk achievement worth" respectively. Other approaches for ranking may be acceptable. GE's use of alternate methods should be discussed with the staff. References 2-5 discuss various alternate methods for quantifying system value.

(3) Based on the above, GE should identify promising means of risk reduction and perform preliminary cost estimates for a selected set of improvement schemes based on discussions with the NRC staff.

(4) Following further discussion with the staff, GE should perform detailed risk, incremental risk, and cost benefit analyses for a selected subset of potential design improvements.

REFERENCES

1. NUREG/CR-3385, "Measures of Risk Importance and their Applications," July, 1983.

2. NUREG/BR-0058, "Regulatory Analysis Guidelines of the U. S. Nuclear Regulatory Commission," NRC/EDO, January 1983.

3. NRR Office Letter No. 16, Revision 1, Regulatory Analysis Guidelines," March 14, 1983.

4. NUREG/CR-3568, "A Handbook for Value Impact Assessment," Pacific Northwest Laboratory, December 1983.

5. General Electric Report APED-5538, "The Design Structure System," September 1968.

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