ATTACHMENT 2

(13)

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

(1)

AUG 0 1 1983

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

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

Letter To GE 4/13/84

SUBJECT: REVIEW OF GESSAR-II DESIGN IMPROVEMENT

The CP/ML Rule, 10 CFR 50.34(f)(1) requires license applicants to perform certain studies and "...ensure that the results of such studies are factored into the final design of the facility." 10 CFR 50.34(f)(1)(i) states:

> "Perform a plant/site specific probabilistic risk assessment, the aim of which is to seek such improvements in the reliability of core and containment heat removal systems as are significant and practical and do not impact excessively on the plant (II.B.8)."

In accordance with the CP/ML Rule, GE has submitted a PRA for the GESSAR-II standard plant FDA application which the staff is currently reviewing. In performing our review, we should ensure that an adequate effort has been made by GE to seek out and evaluate various potential improvements in plant design aimed at reducing overall plant risk.

To allow us to assess the degree to which overall plant design improvements have been considered for GESSAR-II, we wish to compile the relevant documentation. We believe the compilation will prove useful in forthcoming licensing actions, including rulemaking. Accordingly, please provide me with a list of questions, issues, studies, and analyses pertaining to significant design improvements that have been pursued with GE during your respective staffs' review of GESSAR-II. You should examine, within reasonable bounds, substantive design alternatives. These questions will of their very nature go beyond the bounds of the traditional SRP review which is designed to show conformance with the regulations. If, in assembling your list, you are able to identify additional questions that GE has not yet been asked to address, please include these questions as a separate list. Include in this list any specific questions that derive from external event (seismic, etc.) considerations. Any such new questions will be considered in total to ascertain whether or not they should be included in the ongoing PRA review.

Following are examples of the types of questions in which we are interested including two from the current set of Q-2s developed during the GESSAR-II PRA review, and three other general questions:

(1) 720.113
Augmented decay heat removal may be helpful in reducing severe accidents risk. The Germans are considering separate dedicated suppression pool heat removal systems. Provide a discussion of the potential use of such systems in the GESSAR-II design including descriptions of the systems that have been considered by GE and the expected impact of these systems on plant risk. Also include a discussion of the potential that augmented heat removal systems may have for removing the limitations of core retention devices discussed in your response to Part 3 of Question 720.83.

(2) 720.144
In the conceptual design for the advanced BWR's developed by an advanced engineering team comprising General Electric (United States), Toshiba and Hitachi (Japan), Asea Atom (Sweden) and Ansaldo Meccanica Nucleare (Italy), an electrically (as opposed to hydraulically) operated high speed scram CRD has been recommended. This would provide higher scram reliability and better load following by allowing unrestricted control rod operation at high powers. Please provide an assessment of potential reduction in the core damage probability and overall plant risk by adopting the new CRD design as compared to the current CRD design in GESSAR-II plants.

(3) Discuss the advantages and disadvantages of the inclusion of an integral containment basemat in GESSAR-II and the effect on plant risk.

(4) Discuss any potential advantages in the relocation of plant equipment that could significantly alter the outcome of the dominant accident risk sequences and reduce risk.

(5) Discuss the utility of providing additional standby power sources and/or the use of diverse sources of motive power. Also discuss any potential advantages and disadvantages associated with the use of electrical crossties.

If you have questions, please call Jack Rosenthal (X29447).

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

cc: R. Mattson
RSB S/L's
J. Meyer
A. Thadani
D. Yue
D. Scaletti
C. Thomas

D. SCALETTI

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(2)

APR 13 1984

Docket No. 00007447

Dr. Glen G. Sherwood, Manager
Safety & Licensing Operations
Nuclear Power Systems Division
General Electric Company
175 Curtner Avenue, Mail Code 682
San Jose, California 95125

Dear Dr. Sherwood:

Subject: Request for Additional Information Regarding the Severe Accident Review of GESSAR II

As you are aware, the Commission's proposed policy relating to Severe Accidents would require, in part, that an application for a design approval comply with the requirements of 10 CFR 50.34(f) (CP/ML Rule). Rule item (f)(1)(i) requires the applicant to assess improvements in the reliability of core and containment heat removal systems that are significant and practical and do not impact excessively on the plant. To aid you in the assessment of this item, the staff has prepared the enclosed list of potential design improvements for your consideration.

Please consider the following guidance in your discussions of the potential design improvements for GESSAR II:

(1) GE should discuss each item on the list and provide a qualitative assessment of the relative advantages and disadvantages. 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 by 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.

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(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.

This request for information has been previously discussed with members of your staff and they have agreed to provide the initial response to this request by April 16, 1984. If you have any questions regarding this request, please contact Dino C. Scaletti, at (301) 492-9787.

The reporting and/or recordkeeping requirements contained in this letter affect fewer than ten respondents; therefore, OMB Clearance is not require under P. L. 96-511.

Sincerely,

Cecil O. Thomas

Cecil O. Thomas, Chief
Standardization and Special
Projects Branch
Division of Licensing

cc: w/enclosure
See next page

General Electric Company
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Office of Nuclear Energy
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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. [illegible],

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.

(3) Regarding Item No. 6, the specific requirements in the CP/ML Rule (10CFR50.34(f)) dealing with hydrogen control were imposed so as not to foreclose future 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 will be entertained by the NRC.

g. safety related Condensate Storage Tank (protected from natural phenomena) with capability for a 16 hr. station blackout,
h. 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, water source, AC/DC dependencies, installation of a dedicated system, and ability to connect to a backup water supply (e.g., a fire truck).

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 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., like the replacement of 3 stage

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 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.

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.

ENCLOSURE

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   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.

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