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

JUN 9 1982

MEMORANDUM FOR: Joseph D. LaPleur, Jr., Assistant Director for International Cooperation

FROM: W. F. Kane, Project Manager, Licensing Branch No. 1, DL

SUBJECT: EXPERT REVIEW OF KRSKO STEAM GENERATOR CHANGES

Your memorandum to D. Eisenhut dated May 26, 1982 requested initial comments by NRR experts on the modifications and additional information needed to complete their review with final comments scheduled for June 25, 1982. Our experts assigned to this activity have completed the first stage of their review. Their initial comments and the identification of additional information needed to complete their review are contained in the enclosure.

We note and must preamble our comments with the fact that the basic approach at KRSKO is a "Systems fix". Since the proposed modifications at KRSKO now envision using the auxiliary feedwater system in a manner for which it may not have been originally designed, a very careful rereview of all aspects of the plant with this in mind is appropriate. The NRR experts have not attempted to perform such a review.

Please let me know if you have any questions regarding the enclosed material.

W. F. Kane, Project Manager
Licensing Branch No. 1
Division of Licensing

Enclosure:
As stated

cc: H. Denton
E. Case
V. Stello
D. Eisenhut
R. Vollmer
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T. Rehm

ENCLOSURE

1. The main feedeater system modifications proposed by Westinghouse for the D-4 type steam generators of the KRSKO Nuclear Power Plant seem reasonable based on our initial review of the system and the proposed modifications. A small purge flow through the main feedwater nozzle during 0-20% power and a small tempering flow through the auxiliary feedwater nozzle during 20-70% power reduces the risk of water-hammer in the preheater region and thermal shock to the auxiliary feedwater nozzle, respectively.

2. There is a discrepancy in the feedwater flow control scheme between the feedwater system description prepared by Gilbert Associates, Inc. and the feedwater system control valves operation curves provided by Westinghouse.

Gilbert Associates	Westinghouse
0-20% power FBCV only	0-20% power FBCV only
20-70% power FCV	20-60% power FCV
70-100% power FCV (constant flow at 70%) Plus FACV	60-90% power FCV (constant flow at 60%) Plus FACV
	90-100% power FACV (constant flow at 30%) Plus FCV

3. The split flow scheme is designed to limit no more than 70% flow through the steam generator preheater. Although a high flow alarm is provided for the operator's action, flow limiting provisions (e.g., orifice or valve control) would be preferred.

4. The Westinghouse scheduled thermal hydraulics and stress analysis to determine the aux/main feed combined impacts should consider the worst combination of the aux/main feed flow assuming control system malfunction.

5. The main feedwater line break should be reanalyzed assuming a break in the 16" line at the main feed nozzle with 30% feedwater continuously feeding the broken steam generator through the auxiliary feed nozzle before the feedwater isolation signal is generated.

6. The piping design should be checked to assure that down-turned elbows are placed immediately upstream of the main and the auxiliary feedwater nozzles to mitigate water hammer. The idea is to minimize the horizontal lengths between the steam generator and the vertical run of piping.

7. According to BNL-NUREG-51248, "An Evaluation of Condensation-Induced Water Hammer in Preheat Steam Generators," a water hammer test is recommended at 20% of full power by using feedwater through the auxiliary feedwater nozzle, at the lowest feedwater temperature that the plant standard operating procedure (SOP) allows and then switching the feedwater at that temperature from the auxiliary feedwater nozzle to the main feedwater nozzle by following the SOP. The transient should be observed and recorded. It should be noted that at low loads, there will be vapor voids at the preheater section of the steam generator.

8. The complicated new control system may lead to a higher probability of system malfunction and/or feedflow instability.

9. Please provide block diagrams of the control systems showing input parameters and output control signals. These diagrams should clearly differentiate safety-grade and non-safety-grade portions of the systems.

10. Please provide a discussion of plant operation near the power region where the flow split occurs - i.e., near 70% power - to verify that stable control system operation will occur at this power level.

11. Please provide additional information describing which valves are automatically operated and which are manually operated.

12. Discuss the purpose of the "loop feedwater isolation" discussed on page 16.

13. Please provide failure modes of the various solenoid valves, control valves, and isolation valves on loss of electric power, instrument air, etc.

14. Please provide a description of the consequences if the control system fails and results in an incorrect flow split. Additonally, described how the failure is detected and how rapidly operator action must be taken.

15.

16. [redacted]

17. [redacted]

18. Additional information is needed on the flow distribution in the Model D4 steam generator tube bundle. It is not clear how the flow from the auxiliary feedline affects the main feed flow and how it is distributed at different power levels.