POWER AUTHORITY OF THE STATE OF NEW YORK

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June 8, 1979
JPN-79-32

Director of Nuclear Reactor Regulation
United States Nuclear Regulatory Commission
Washington, D. C. 20555

Attention: Mr. Thomas A. Ippolito, Chief
Operating Reactors Branch No. 3
Division of Operating Reactors

Subject: James A. FitzPatrick Nuclear Power Plant
Docket No. 50-333
Request for Plant Start-up

Dear Sir:

On March 13, 1979, the Nuclear Regulatory Commission (NRC) issued a Show Cause Order requiring the Power Authority of the State of New York (Authority) to shut down the James A. FitzPatrick Nuclear Power Plant (JAFNPP) because of NRC concerns about the ability of certain safety related piping systems to withstand seismic events.

This letter requests authorization to start up the JAFNPP contingent upon completion of the piping stress reevaluation effort and any necessary modifications to constraints in inaccessible areas. Enclosure (1) reports the status of actions being taken to reevaluate safety related piping systems in JAFNPP in a manner currently acceptable to the NRC and addresses the information requested in Mr. Stello's letter of April 2, 1979.

A total of 96 piping system packages (problems) were originally seismically analyzed using a computer program employing intramodal algebraic summation. Of these, 33 problems concern those systems inaccessible during operation and main steam and feedwater systems up to the outboard containment isolation valves. The remaining 63 problems concern systems accessible during normal operation.

All 96 problems have been field verified.

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As reported in Enclosure (1), the pipe stresses in nearly all of these field verified problems have already been reevaluated. To date, these pipe stresses all have been within allowable limits. We are confident that no pipe stresses in any problem will exceed allowable limits as a result of this reevaluation using currently acceptable techniques.

Reevaluation of pipe constraints in affected systems also is proceeding. A pipe constraint is a pipe hanger, restraint, snubber, wall penetration or equipment nozzle. This effort is much more time consuming. Based on the results of the reevaluation of JAFNPP to date and of other plants similarly being reevaluated, we believe that nearly all of these constraints could be shown to be acceptable as is, given sufficient time more precisely to model the constraints and by employing sophisticated analytical techniques. Nevertheless, we are expediting completion of the overall reevaluation effort by directing that any constraints which cannot readily be shown acceptable, be modified. Based on this approach, it is expected that all constraints in inaccessible areas will be confirmed satisfactory by July 1, 1979. The current estimate for completely confirming the adequacy of all constraints for accessible areas is October 1, 1979. The effort to complete the full reevaluation of all safety related piping systems will continue on an expedited basis and any questionable constraints found will be resolved expeditiously.

Assuming that our expectation that no recalculated pipe stresses will exceed allowable stresses, and contingent upon satisfactory completion of the reevaluation and/or necessary modifications of constraints, permission is now requested to start up. As indicated above, we anticipate fulfilling these conditions by approximately July 1, 1979.

Program Plan

1. Field verify all 96 problems (Done).

2. Complete piping stress reevaluation on all 96 problems.

3. Evaluate all constraints on the 33 lines which are inaccessible and repair, modify, or confirm satisfactory as appropriate.

4. Extrapolate results of pipe support evaluation to the 63 lines which are accessible.

5. Start up plant.

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6. Continue evaluation of all pipe supports in the 63 accessible lines on an expedited basis. Completion date of this effort to be determined based on experience to July 1, 1979.

Justification for Adequacy of Piping Systems

As we have indicated previously, the recalculations using present-day conservative accepted techniques have not identified gross and numerous cases of overstress. In our opinion, there are sound engineering reasons why gross and numerous overstress situations are not being found in JAFNPP.

There is an evolutionary nature of computer programs and the nature of their use in the overall design process. The newer techniques provide a means for obtaining more uniformly conservative results.

The computer programs are calculational tools used to predict forces and resultant stresses that may occur during an earthquake. Such predictions are an integral, but not necessarily the most important, part of the total process of establishing design adequacy of piping systems. The present seismic evaluation programs utilize more refined calculational techniques, but they still provide only one stress component among several that must be considered, viz., thermal, pressure, deadweight. Furthermore, system modeling and the assumed characteristics of the earthquake used for design has greater impact on the solution than the method of intramodal force combination.

It is a well known and demonstrable fact that piping is not particularly sensitive to seismic events. Such simple, commonly-used design techniques as fastening equipment and restricting the movements of large masses are sufficient to assure a high level of integrity. Further, the various evaluation approaches generally show large differences at low stress levels and small differences at high stress levels.

Hence, we feel that the overwhelming body of evidence, both from the conservative development of the piping analysis methodology, and the observed performance of piping systems during earthquakes, leads to our conclusion that the piping systems of the JAFNPP are adequate. This has been confirmed by our reevaluation program. The details of this program are described below.

Reevaluation Methodology

Following verification of the "as-built" configuration, the computer model for the system was recoded, if required, and a computer run was made using a verified computer program. If the pipe stress results were within allowable limits, the evaluation sequence proceeded to the review of supports, nozzles, and penetrations (see below). If the results were to indicate a possible stress condition in excess of allowable, the system model would be scrutinized in greater detail, revised utilizing current, more sophisticated techniques still consistent with the original licensing bases, and rerun. If the results still indicated a possible stress condition in excess of allowable, the system would then be evaluated using current methodology consistent with the original licensing bases and with current requirements. If this latter rerun did not resolve the problem, additional supports or snubbers would be considered.

Following completion of a pipe stress run where the recalculated loads were within allowable limits, the support and end-reaction loadings were tabulated and compared with the original loadings. If the loadings were equal to or less than the design limits, the supports or nozzles or penetrations involved were considered acceptable. If the loadings were above the original design limits, new calculations or supplements to the original calculations were performed, using techniques licensed for JAFNPP. The item was then determined to be either acceptable or in need of modification or replacement. If nozzle reactions exceeded those initially approved, vendors were contacted for approval of the new loadings. The vendor either approved the new reactions or requested reductions.

Consequences of Continued Shutdown

The consequences of continued shutdown of the JAFNPP upon the Authority's customers are severe and must also be considered.

The Authority uses about 40% of the output of the JAFNPP to supply power to several high load factor industrial customers in New York State. The remainder is sold to seven utilities in New York State for distribution to their own customers, with the preponderance of this power in the summer months going to summer peaking companies having very high cost oil-fired generating capacity. The generating plants of the Authority are used together with those of the other seven members of the New York Power Pool (NYPP) to serve the aggregate requirements of New York State with maximum reliability and economy. Operation of the NYPP is coordinated with that of the neighboring regions in order to maximize regional reliability and make optimum use of available generating capacity.

The Authority has purchased and will continue to purchase as much energy as possible from Hydro Quebec whether or not the JAFNPP is in service. Energy is also being purchased by the NYPP from other neighboring systems wherever energy is available and will result in savings to New York consumers. Nevertheless, the energy lost from the shutdown of the JAFNPP is being replaced by high cost oil-fired generation. The JAFNPP replaces about 32,000 barrels of oil per day when operating at full output. The cost of replacement energy in New York State is estimated to be over $400,000 per day at this time. We expect oil prices to continue to rise this summer.

Discussion of Conservatisms

There are conservatisms applicable to the JAFNPP unit which are not theoretical concepts, but indeed are real and existing margins of safety. To quantify these conservatisms is difficult, but this in no way negates the sound conservative premise on which the JAFNPP reevaluation effort is based. Some of these conservatisms are discussed below.

1. Combination of Stresses/Loads

   The maximum stress values for each loading condition are combined to determine the total maximum stress for a piping line. Since the maximum stresses for each loading condition are combined regardless of the point of occurrence in the line, the calculated total maximum stress conservatively envelopes the actual maximum stress occurring at any point in the line.

   The original analysis employed the coincident application of maximum pressure, temperature and fluid discharge loads even though their occurrence may not be simultaneous. Consideration of the separate application of these loads will result in reduced loads.

2. Damping Values Utilized in the Analysis

   Elastic dynamic analyses are performed using conservatively low damping values. The use of lower damping values increases the seismic responses and thus contributes to the margin of safety.

3. Enveloping of Floor Response Spectra

Where a component, such as a pipe, has numerous supports, the envelope of the response spectrum of the various support points is applied to all the support points so that conservative seismic loads are generated for design purposes.

4. Spacing of Supports

Seismic restraints and spacing were determined using conservative preliminary spacing tables. If subsequent computer analysis showed that the seismic stress and loads were low, the designed supports were not eliminated (i.e., optimization of the pipe/support system was not undertaken).

5. Design of Supports

Because of the large number of supports, simplified analytical approaches which gave conservative results have been utilized in the design process. Utilization of more sophisticated analysis techniques, especially for complex support configurations, will result in significant increases in the actual load carrying capacity of the supports.

6. Effect of Inelastic Behavior on Dynamic Responses

For cases where piping materials are subjected to small excursions into the inelastic range, the dynamic response is reduced as a function of the amount of inelastic action. This can be represented by a ductility factor which is 1.0 for purely elastic behavior. A ductility factor of up to 1.5 can be assumed for vital piping. This would have the effect of reducing accelerations of elastically calculated response spectra by as much as 1/3.

7. Seismic Load Envelopes

When calculating the seismic loads for components, conservatively established values are applied several times (first, to major structures, then to the intermediate structures and finally the equipment themselves).

8. Specified Minimum Strength of Materials

   Engineering codes specify "code minimum strength" for materials. Insitu strengths are usually higher.

9. Contribution of Seismic Loads

   Loading combinations consider other loadings (dead weight, live loads, pressure loads, etc.) in addition to seismic loadings. Seismic loading is therefore only part of the total loading and in fact, loadings other than seismic, may govern designs. A sizeable increase in seismic stresses may be only a small addition to the total stresses.

10. Application of Amplified Response Spectra (ARS)

    Conservatisms are also inherent in the method by which a particular ARS is selected for application to inertia force determination in each piping problem. Since pipe runs generally extend over a range of elevations from beginning to end of run, and since the magnitude of acceleration associated with each ARS increases with elevations in a structure, the ARS applied in analysis of each run is selected coincident with the higher elevations along each piping run.

11. Multiple-directional seismic input, with each horizontal component having equal intensity, is considered in design of plants. Actual earthquakes are typically strongest in one direction.

12. Pipe and structural support members are selected from standard available sections, and consequently have generally greater strength than the minimum requirements by the analysis. Hence, the computed stresses are often lower than the allowable stresses. This difference constitutes an additional margin in the actual plant.

The end result of applying the actual and inherent conservatisms is that structures, systems and components have seismic capability in excess of the established design goals. There is normally no motivation to go back and assess the true as-built design margins because the costs of reevaluation and time lost would be significantly greater than any benefits obtained from this type of an

optimization. The specific information necessary to quantify these conservatisms in the licensing process is therefore not usually developed. However, it should be noted that because of licensing requirements, each step of the design process has both actual and inherent conservatisms built in. The sum of these individual design steps and associated conservatisms exceed by far the effects of any perturbations within a single design step.

NRC I&E Bulletin 79-02

The program responding to NRC I&E Bulletin 79-02 is being applied to the pipe supports involved in the 96 problems. Enclosure (2) provides information concerning this program. Should modification of a support or restraint be necessary to meet the recalculated applied loads, the base plate and anchor bolts will be designed in conformance with the criteria of Bulletin 79-02, if a concrete anchor bolt design is used. A complete response to I&E Bulletin 79-02 is being prepared separately.

Very truly yours,

Paul J. Early
Assistant Chief Engineer-
Projects

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