Washington Public Power Supply System
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Docket 50-508
June 15, 1983
G03-83-476

Director of Nuclear Reactor Regulation
Attn: Mr. G. W. Knighton, Chief
Licensing Branch No. 3
Division of Licensing
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Subject: NUCLEAR PROJECT 3
RESPONSES TO NRC QUESTIONS ON PIPE CLAMPS

Reference: a) Letter G. W. Knighton to R. L. Ferguson, dated 04/04/83.
b) Letter #G03-83-384, G. D. Bouchey to G. W. Knighton, dated 05/05/83.

Reference a) transmitted to the Supply System a set of seven requests for additional information regarding the useage of ITT Grinnell pipe clamps at WNP-3. Reference b) committed the Supply System to respond to Reference a) by June 1983.

Responses to these questions are included as attachments to this letter.

Should you have any questions or desire further clarification, the Supply System point of contact for this matter is Mr. K. W. Cook, Licensing Project Manager (206/482-4428, ext. 5436).

Sincerely,

SD Bouchey

G. D. Bouchey, Manager
Nuclear Safety and Licensing

AJM/ss

cc: J. A. Adams - NESCO
Ebasco - Elma
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WNP-3 Files - Richland
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ATTACHMENT

Responses to NRC Questions 210.14 through 20.

14) Your response to Question #1 in your letter from G. D. Bouchey to F. J. Miraglia dated July 30, 1982 is not acceptable. Code Case N-249 states that the maximum measured UTS of "Component support materials should not exceed 170 ksi in view of the susceptibility of highstrength materials to brittleness and stress corrosion cracking". Under those conditions the Code Case recommends that:

(1) the impact test results for the material meet Code requirements, and

(2) the material is not subject to stress corrosion cracking by virtue of the fact that

(a) a corrosive environment is not present, and
(b) the component that contains the material has essentially no residual or assembly stress and it does not experience frequent substantial loads in service.

Provide additional information to address the above two concerns if the maximum UTS of the clamp strap material exceeds 170 ksi.

ANSWER

Table 1-7-1 of the code indicates that the subject strap material has a reduction in toughness at room temperature after exposure for about 5,000 hours to temperatures at 600°F and after shorter exposure above 650°F. In 98% of the WNP-3 applications the operating temperature is less than 500°F. Therefore, in the case of these applications, the material should not be susceptable to brittle fracture. The remaining 2% of the clamp applications will be reviewed on a case by case basis. In those instances where this cannot be tolerated the design of the support will be changed.

Code Case N-249 also includes cautionary notes on the use of materials where the UTS exceeds 170 ksi. It requires impact testing of such materials as a condition. In the application of the strap material, however, the impact test is not required because of its thinness. NF Code Paragraph NF-2311, Component Supports for Which Impact Testing of Material is required, specifically excludes the impact testing of materials with a nominal section thickness of 5/8 inch or less.

Chemical contaminants which could cause stress corrossion in the strap material are sea water, aqueous solutions containing chloride, and hydrogen sulfide solutions. These clamps are designed for plant ambient conditions. The environment in the containment during a LOCA will have a boric acid concentration of 4,400 ppm and sodium hydroxide with pH of 8 1/2 to 11. These concentrations will not affect the strap material. No appreciable concentrations of chlorides have been identified. In the absence of a corrosive environment stress corrosion induced cracking cannot by definition occur.

15) The response to Question #2 in your July 30, 1982 letter needs further clarification. Provide clarification of what the correlation between a pressure stress of 15,000 psi and a temperature increase of 17°F is intended to indicate.

ANSWER

The 17°F indicated in the original response to Question #2 was incorrect The radial deflection of pipe due to an internal pressure of 15,000 psi is the same deflection which would occur if the pipe temperature was increased by 53°F. This was intended to indicate the relatively insignificant effect of high internal pressure.

16) In your letter from G. D. Bouchey to G. Knighton dated February 25, 1983, a response was provided to address the test program which was intended to determine the clamp-induced stresses in the piping. Your response indicates that the clamp preload "resulted in too wide a load range" being enveloped due to the degree of simplicity in the test procedures.

(a) Provide a summary of the test results to date and the impact it has on the piping and clamps already installed at the WNP-3 facility.

(b) Provide justification that the test torque preload applied to the clamps on representative pipe sizes will determine the limiting pipe conditions for clamp application.

(c) Provide a clarification of the test to be performed on the tensile test machine and assurance that the strain gauges will record the maximum stress locations due to the total combined stresses from both torquing and bending modes.

(d) Provide the test report when complete.

ANSWER

a) Test results to date indicate that for at least some cases clamp induced stresses are excessive. Minor clamp design modifications are being examined to increase the pipe to yoke contact area to improve load distribution thereby reducing stresses. Some clamps have been installed. These will be retorqued when the proper torque has been established.

b) The testing of the clamps was not done for one specific value of torque but rather for a series of incremental values of torque. Lift-off loads and pipe wall stresses were obtained at each step. The relationship between torque and lift-off load was proven to be a linear one. This relationship will be used to derive the final torque values as a function of the actual loads. Based on the test results, a conservative relationship between torque and pipe induced stresses will be derived and used to show compliance with the pipe code equations.

c) The stresses due to the "Bending Mode" will be obtained from the regular piping stress analysis. The local effects due to the interaction between clamp and pipe wall be determined by tests by measuring the stresses due to pretorque and stresses due to pretorque & applied load.

The test procedure is as follows: 1) The clamp/pipe assembly is placed in a dynamometer, pretorqued in incremental steps and for each step the lift-off load is determined. 2) The clamp is then untorqued and pretorqued again, also in steps and at each step an external load equal to the corresponding lift-off load is applied in both directions (tension and compression). Strain measurements are taken at each step for the cases of torque alone, torque & applied load (tension) and torque & applied load (compression). The stresses due to both effects (bending mode & local effects) at each restraint point will be combined and evaluated against the appropriate code allowables.

d) Test results will be provided when complete.

17) The response to Question #4 in your July 30, 1982 letter is not acceptable. Bolt torque is a poor indication of bolt tension and a poor indication of strap tension unless the friction is controlled both in the bolt and in the strap. Provide the measurements that will be taken to assure that the strap tension required for proper clamp stiffness is adequately applied without causing undue stresses in the piping.

ANSWER

The load rating procedure as defined by the NF Code does not address the specific stresses that are incurred by the component under load. The load rating of the component to satisfy particular operating conditions is based on the applied load at which the component fails to perform its required function multiplied by the ratio of allowable stress at temperature to the specified minimum tensile strength of the support material. In the stiff clamp, when the applied torque and the applied load are below those at which the clamp was rated there is no reason to determine stress levels in the component. The proper application of torque to establish pretension is an industry acceptable method. The torque values that will be specified will prevent lift-off of the clamp from the pipe at the specified emergency load rating of the component, and will resist lift-off up to a load 10% greater than the emergency load when the piping temperature is at the ambient temperature level. (Note: when the piping is at an elevated temperature, the lift-off load will increase due to the increased tension in the straps), as long as lift-off has not occurred proper clamp stiffness is assured. The torque value to arrive at the lift-off load will be obtained from tests. Pipe stresses under torque and emergency load conditions will be determined by test and will be combined with all existing stresses to assure compliance with code allowables.

18) The clamp preload is required to achieve adequate clamp stiffness values to prevent the clamp from lifting off the piping during dynamic loadings.

(a) Provide the basis for assuring that the required torque preload will not relax during the lifetime of the plant.

(b) Provide preload measures that will be taken to assure that the required preload is clearly marked or identifiable for each clamp to prevent undertorquing or overtorquing the clamp at any time after installation.

ANSWER

(a) A torqued clamp was checked after a period of a month and no relaxation was evident. In the temperature test, a check after ten cycles did not indicate any reduction in torque. The margin of torque to assure no lift-off is ten percent over the maximum rated load of the stiff clamp component.

(b) Site Installation Constructor's have a program to assure that all field work during and after installation are controlled such that there are no physical modifications without a Contractor Engineering approved work package (or traveler) which includes procedures listing the appropriate torque settings by Stiff Clamp Frame and Pipe size. The Stiff Clamp itself is provided with a metal tag which denotes the following:

...Frame Size
...Component to be used with the Strut or Snubber, and Component Size
...Pipe Size
...Support Mark Number

In addition, following the final torque setting the stiff clamp studs and nuts will be marked. This measure will allow a quick visual inspection to determine if the position of the nuts and studs have been altered.

The control provided during and subsequent to installation, and the marking of the studs and nuts after torquing, provides the necessary measures to prevent over or under torquing.

19) The response to Question #8 in your November 11, 1982 letter is not adequate. The strap preload relaxation was tested under thermal conditions by placing the pipe and clamp assembly in an oven and thermally cycled the assembly ten times. The test does not simulate the actual operating condition where the pipe will expand thermally before the clamp due to the temperature gradient caused by the internal pipe temperature. The applicant should provide the basis for assuring that the preload relaxation due to thermal and pressure cycling of the pipe will not occur.

ANSWER

The testing performed in response to the original question, (see Attachment), was a test designed to test the effects of pressure and temperature cycling on the preload on the straps, not its effects on piping stresses. Piping stresses will be determined from the test program discussed in the response to Questions #2 and #16. There was sufficient conservatism in the test program to indeed prove that the straps would not relax. For example, the testing was done on a heavy wall stainless steel pipe and at a temperature of 650 degrees F. The Load Capacity Data Sheet for this clamp limits the use of this clamp to 350°F for use with stainless steel piping. Due to the thinness of the straps in contact with the pipe the differential temperature effects will be minimal. A copy of the test report is provided as an Attachment to this response.

20) Provide the basis for assuring that the clamp yoke will not cause excessive local stresses in the piping during dynamic load application.

ANSWER

Clamps are selected to assure that the applied load will not exceed the maximum rated load of the component. The induced stresses due to that load, applied in tension and compression, will be combined with the pipe bending stresses to assure that code allowables have been satisfied. This is true regardless of whether the total applied load is dynamic, static or a combination of each.