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Washington Public Power Supply System
A JOINT OPERATING AGENCY

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Docket No. 50-397

August 8, 1979

Nuclear Regulatory Commission
Suite 202, Walnut Creek Plaza
1990 N. California Boulevard
Walnut Creek, CA 94996

Attention: Mr. R. H. Engelken, Director

Subject: WPPSS NUCLEAR PROJECT NO. 2
IE BULLETIN NO. 79-07

Dear Mr. Engelken:

In response to the subject bulletin, WPPSS submits the following information for its project WNP-2.

It has been determined that, eleven WNP-2 balance-of-plant piping systems were analyzed utilizing algebraic summation but have subsequently been re-analyzed and have been found to be within code limits for pipe stress allowables and all supports and supplemental structures are within current rated load capacity. (See Attachment I)

With respect to GE, the NSSS supplier, review of the IE Bulletin resulted in the determination that none of the computer codes used for the seismic analysis of GE piping systems important to safety employed the techniques identified in Item 1 of subject bulletin. With regard to Item 3, GE will use SAP/PISYS computer programs for the seismic piping analysis. A description of these programs and the verification procedure is presented in Attachment II.

Should you have any questions regarding this response, please contact me.

Very truly yours,

D L Renberger

D. L. RENBERGER
Assistant Director-Technology

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Attachment

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Attachment I
(Numbers refer to IE Bulletin item numbers.)

1) A version of the ADLPIPE Computer Program which includes an algebraic summation technique, has been used to do seismic analysis of safety-related piping.

The items listed under Item 1) in the subject bulletin do not describe explicitly the summation techniques used in ADLPIPE for determining final mathematical model responses.

This version of ADLPIPE Computer Program uses the intramodel algebraic summation for co-directional components resulting from multiple earthquake directional motions. The Square Root of the Sum of Squares summation is used to determine the combined response for all modes to obtain directional forces at a point in the pipe system. Closely spaced modes (within 10%) are absolutely summed.

2) The ADLPipe Computer Program is a proprietary program owned and technically supported by:

Arthur D. Little, Inc.
Acorn Park
Cambridge, MA 02140

The Computer facilities, where Burns and Roe engineers utilize ADLPIPE Computer Program, have been directed to forward to the U.S. NRC listings as called for in Item (2) of the bulletin.

This direction specifically asks that this listing contain Old Versions of ADLPIPE from 1972 up to the present version.

3) For operational piping analyses, Burns and Roe has exclusively used Arthur D. Little piping analysis program, ADLPIPE. This computer program was the only program in the public domain which considered the nuclear piping requirements for the Code, ANSI-B31.7.

In the year 1972, an updated version enabled the user to produce a partial stress report required to meet the requirements of the B&PV ASME Section III, Division 1 Code, as well as ANSI B31.1 Code for piping and components. It also contained, for the first time, a spectra modal response analysis for redundant pipe systems.

Burns and Roe also has an ongoing validation program. Typical spectra response and time history analyses from the ADLPIPE Program have been compared with the results from ANSYS and STARDYNE Computer Programs. Minor differences, due to different numerical techniques used within the programs, have been identified but verification has been demonstrated by these comparisons.

In addition, the following comparisons have been made of the different summation options of ADLPIPE against other recognized industry methods and benchmarks.

I. Comparison of ADLPIPE vs. NUPIPE Computer Program - This study included eight (8) typical pipe systems having various diameter pipe sizes.

ADLPIPE Algebraic Summation vs. NUPIPE
ADLPIPE Option 192 vs. NUPIPE
ADLPIPE Option 160 vs. NUPIPE

II. Second comparison of ADLPIPE Program was to selected problems in report BNL NUREG-21241-R2 issued by Department of Nuclear Energy Brookhaven National Laboratory.

ADLPIPE Algebraic Summation vs. BNL Hovgaard Problem
ADLPIPE Option 192 vs. BNL Hovgaard Problem
ADLPIPE Option 160 vs. BNL Hovgaard Problem
ADLPIPE Algebraic Summation vs. BNL Coffee Table Problem
ADLPIPE Option 192 vs. BNL Coffee Table Problem
ADLPIPE Option 160 vs. BNL Coffee Table Problem

4) The following list identifies those piping systems on Washington Public Power Supply System (WPPSS) Nuclear Project No. 2 which have been run on ADLPIPE where Algebraic Summation Intramode has been used.

System	Code/Class
Standby Liquid Control (SLC)	III/2
Condensate (COND)	B31.1
Reactor Water Cleanup (RWCU)	III/2
Heating Steam (HS)	B31.1
Heating Steam Condensate (HCO)	B31.1
Diesel Exhaust (DE)	B31.1
Diesel Exhaust (DE)	B31.1
Diesel Exhaust (DE)	B31.1
Standby Service Water (SW)	III/2
Standby Service Water (SW)	III/2
Spray Pond Ring Header (SW)	III/2

All of the above piping systems have been rerun using ADLPIPE Option 160 and have been found to be within Code limits for pipe stress allowables and all supports and supplemental structures are within current rated Load Capacity.

The plant is fully capable of withstanding the seismic criteria as set forth in the Washington Public Power Supply System, Nuclear Project No. 2, FSAR.

Attachment II

SAP4G Verification

Program Description

SAP4G, a version of SAP, was originally developed for General Electric by F.A. Peterson and K.J. Bathe of the Engineering Analysis Corporation at Berkely. The SAP program is a general purpose structure program used to perform static and dynamic analysis of mechanical and piping components by the finite element method.

Verification

All GE production versions of SAP are verified using a special benchmark problem that exercises all the important features of the program. The benchmark problem has been analyzed for the effects of constraint of free end, distributed forces, and is dynamically analyzed to determine mode shapes and natural frequencies using Swanson System's ANSYS program. ANSYS was also used to predict dynamic response spectra and time histroy integration methods. The predicted frequencies, mode shapes, and loads were compared to the corresponding SAP ANSYS before SAP was qualified for production use. In order to test unique features of SAP that cannot be compared to the results of another program, a special problem is devised which has an equivalent computer or manually calculated solution. Before any new version of SAP is verified, for production application, the benchmark problem is re-analyzed to verify that the program changes have not changed predictions or reduced their accuracy.

PISYS Verification

Program Description

PISYS is a computer program specializing to analyze piping systems. The PISYS program provides a highly flexible user oriented input format for piping system modeling. The analysis modules of PISYS are taken directly from the SAP4G program.

Verification

Since PISYS analysis modules are identical to SAP4G, a SAP analysis of a typical BWR steam piping system is used as a benchmark problem for PISYS verification. The steam line is analyzed for thermal expansion, dead weight, and a variety of dynamic loads in order to exercise all the features of PISYS. PISYS was not verified as a production program until the predictions of SAP and PISYS were shown to be identical for practical purposes.

Before any new version of PISYS is verified for production application, the benchmark problem is re-analyzed to verify that the program changes have not changed the predictions or reduced their accuracy.

Five NRC benchmark problems will also be analyzed as a further verification of the PISYS code. This analysis is expected to be completed and submitted by GE to the Commission for review.