THE CLEVELAND ELECTRIC ILLUMINATING COMPANY

P.O. BOX 5000 - CLEVELAND, OHIO 44101 - TELEPHONE (216) 622-9800 - ILLUMINATING BLDG. — 55 PUBLIC SQUARE

Serving The Best Location in the Nation

MURRAY R. EDELMAN
VICE PRESIDENT
NUCLEAR

September 9, 1983

PY-CEI/NRR-0072 L

Mr. B. J. Youngblood, Chief
Licensing Branch No. 1
Division of Licensing
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Perry Nuclear Power Plant
Docket Nos. 50-440; 50-441
Response to NRC Question
Nos. 210.12 and 210.13 - Fast
Scram Hydrodynamic Loads on
the CRD System

Dear Mr. Youngblood:

This letter and its attachments are provided in response to your request for additional information (dated June 21, 1983) regarding Fast Scram Hydrodynamic Loads on the Control Rod Drive (CRD) System for the Perry Nuclear Power Plant (Units 1 and 2).

The information provided in the attachments will be incorporated into a future FSAR amendment. If you have any additional questions, please feel free to contact me.

Very truly yours,

Murray R. Edelman

Murray R. Edelman
Vice President
Nuclear Group

MRE:kh

cc: Jay Silberg, Esq.
John Stefano
Max Gildner

B001
1/1

210.12 In your January 14, 1983 letter, it was stated that ECHO Energy Consultants was retained to provide a review of all control rod drive system transients. The use of ECHO's proprietary computer program, IMPULSE-I, was used to model these transients and reduce unnecessary conservatism in the piping stress analysis and support design. In accordance with Section 3.9.1 of NUREG-0800, please provide a description of the IMPULSE-I computer program, including the extent and limitation of its application, and the method of verification.

RESPONSE

Computer Program IMPULSE-I

Abstract

IMPULSE-I is an ECHO Energy Consultants, Inc., proprietary computer code which evaluates fluid transients in arbitrary piping networks incorporating a large variety of mechanical equipment such as valves and pumps. IMPULSE includes extensively verified capabilities for simulation of BWR Control Rod Drive (CRD) systems.

IMPULSE-I employs the method-of-characteristics technique with constant time intervals coupled with a large set of mechanical equipment models. The program can completely describe the transient response of a wide variety of mechanical equipment models and boundary conditions such as pumps, valves, surge tanks, Hydraulic Control Unit (HCU) and CRD piston systems.

Program Applications

IMPULSE-I is written in the Fortran V language and is compiled and available on the CYBER 175 and VAX-11/750. Application of the program is limited to piping networks initially containing water or gases with mach number less than 0.6. The wide variety of mechanical equipment components models within the program (i.e., valves, homologous pumps, hydraulic control units) allow application of the program to any general piping system.

Verification

IMPULSE-I was developed, documented and verified according to the criteria and guidelines of ANSI N413-1974, and the ECHO QA Program. The verification uses a combination of published experimental data and hand calculations to test its capability. Twenty test runs provide the basic comparisons of IMPULSE-I with a wide series of experimental data.

210.13 Provide an evaluation of the effect of the fast scram hydrodynamic loads on the integrity of the scram discharge volume (SDV) piping.

RESPONSE

The evaluation of the effect of the fast scram hydrodynamic loads on the integrity of the SDV piping is provided below:

Each finger header (see Figure 1) contains approximately 14 connections through which the Hydraulic Control Units (HCU) discharge to the SDV. Each of these connections to the SDV is in the horizontal plane. Since the piping segments from the HCU to the SDV are very short, the net unbalanced hydrodynamic loads are small (approximately 20 pounds). These loads act in both the horizontal and the vertical directions.

In the horizontal plane, the load at each connection to the SDV tends to be balanced by the connections on the opposite side of the pipe. In the vertical plane, the loads are assumed to occur simultaneously and act in the same direction. The gross load on the SDV finger header would be 20 x 14 = 280 pounds. This load is distributed over a 12 foot span and can be considered to act as a uniformly distributed load of 23.3 lb./ft. The dead weight of this piping is approximately 100 lb./ft. and produces a stress of 1000 psi, which is considered to be very small compared to the normal allowable stresses used in design. The effect of the 23.3 lb./ft. is, therefore, considered to be negligible. The symmetrical layout of this system as well as the supporting arrangement is such that the design requirements are not exceeded when the hydrodynamic loads are applied.

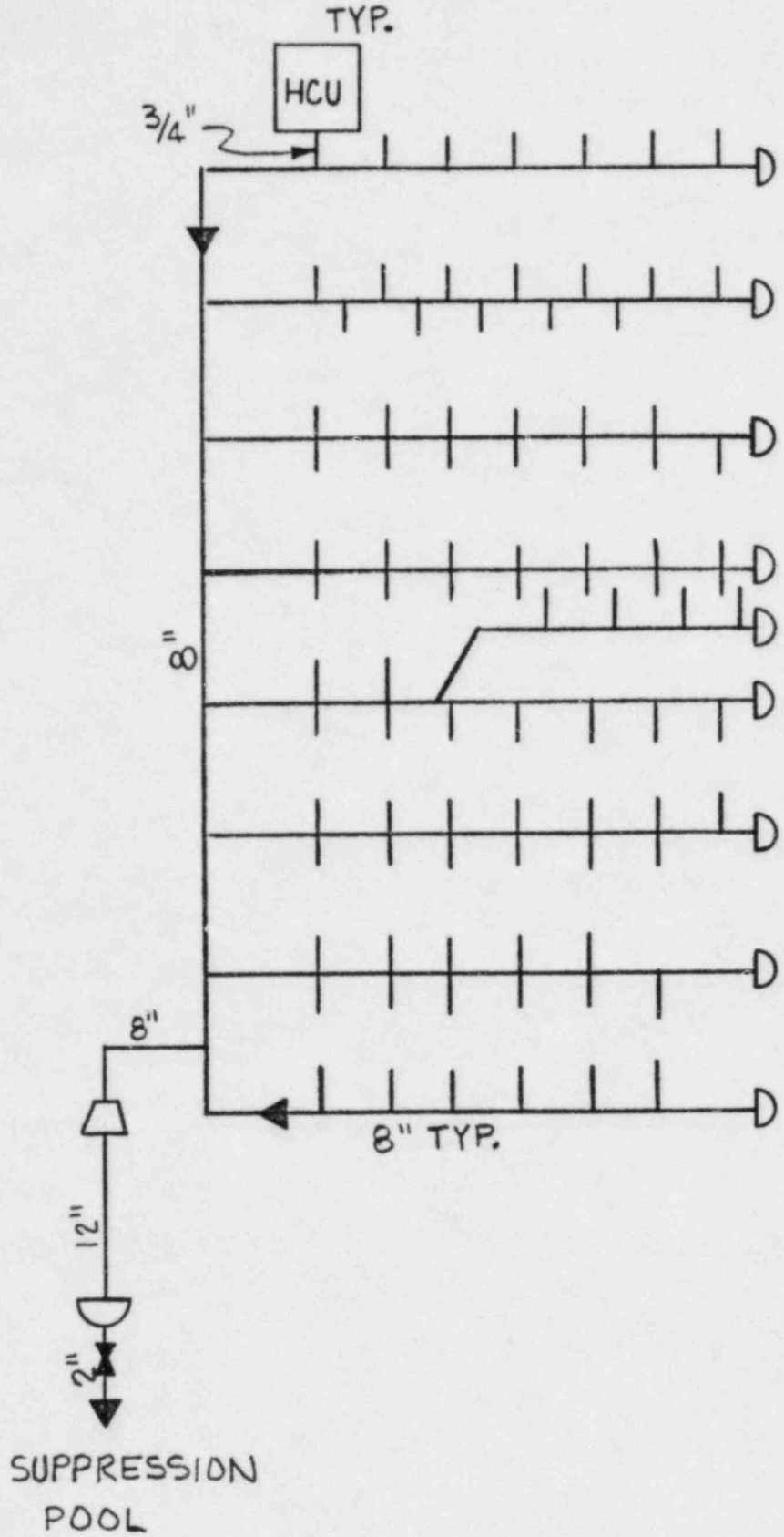

FIGURE 1

SDV Piping