DAIRYLAND Power COOPERATIVE • P.O. BOX 817 • 2615 EAST AV. SOUTH • LA CROSSE, WISCONSIN 54601
(608) 788-4000

October 14, 1980

In reply, please refer to IAC-7181

DOCKET NO. 50-409

Director of Nuclear Reactor Regulation
ATTN: Mr. Dennis M. Crutchfield, Chief
Operating Reactors Branch No. 5
Division of Operating Reactors
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

SUBJECT: DAIRYLAND POWER COOPERATIVE
LA CROSSE BOILING WATER REACTOR (LACBWR)
PROVISIONAL OPERATING LICENSE NO. DPR-45
SEISMIC EVALUATION PROGRAM

Reference: (1) NRC Letter, Eisenhut to Linder, dated August 4, 1980.

Gentlemen:

Your letter, Reference 1, requested that we submit details of our plans for proceeding with a seismic evaluation program and provide justification for continued operation in the interim until the program is complete.

To date, Dairyland Power Cooperative (DPC) has undertaken substantial efforts to evaluate the integrity of the plant and systems essential to safety and safe shutdown.

In 1973, Dairyland Power Cooperative required structural evaluations to be prepared for the Full Term Operating License application. Gulf United Corporation evaluated the adequacy of major LACBWR structures and equipment to withstand the effects of an earthquake event. The Gulf United report (Technical Reference 1) used a ground response spectra, which was developed by Dames and Moore, based on a maximum horizontal ground acceleration of 0.12G for the Safe Shutdown Earthquake. The Gulf United report indicated that high stresses would be generated in some piping systems and building structures during a seismic event and Gulf United indicated that more detailed analyses would be required.

In 1974, DPC contracted Nuclear Energy Services (NES) to review the Gulf United report, provide the detailed seismic analyses on major primary system piping and design pipe restraints, if required. The seismic/stress analyses performed by NES are reported in Technical References 2 through 6 and included the recirculation piping, the

main steam and feedwater piping, and the high pressure core spray suction and discharge piping. NES also reanalyzed the LACBWR and Genoa 3 stacks for seismic effects. This work was reported in Technical Reference 7.

The NES analytical work confirmed that pipe restraints were necessary and DPC had decided to proceed with the design, fabrication and installation of the required pipe restraints. Shortly thereafter, the design work was stopped because the site specific spectra was questioned by the NRC and the potential for soil liquefaction was being evaluated by NRC.

It has recently been determined by NRC that soil liquefaction does not pose a problem at LACBWR and NRC also agreed that the 0.12G value used in previous analyses is acceptable and even conservative. The latter conclusion is based on a comparison of 0.12G ground response spectra developed by Dames and Moore and the LACBWR site specific spectra furnished by the NRC in Technical Reference 8. The ground response spectra developed by Dames and Moore clearly envelops the site specific spectra of Technical Reference 6. Therefore, all of the seismic evaluations of LACBWR structures and piping performed since 1974 by NES were based on a more conservative seismic spectra. It is DPC's intention that all future seismic work required for LACBWR will be based on the Technical Reference 8 seismic spectra.

Since 1978, NES has provided seismic/structural analyses work as required by DPC for the Systematic Evaluation Program. This work is being performed in accordance with the program submitted with this letter as Technical Reference 9. The overall seismic/structural evaluation of major structural components of the LACBWR Containment Building using the conservative ground response spectra of Technical Reference 1 has been completed. These major structural components of the Containment Building include the steel containment shell, the reactor pressure vessel, the outer and inner concrete shield walls, the concrete foundation mat and the pile foundation. The analysis indicated that the overall structural integrity of these major components will be maintained during the Safe Shutdown Earthquake.

Recently DPC has decided to upgrade the shutdown condenser system to an engineered safety system. Part of this upgrading effort consists of seismic analyses of the shutdown condenser, its support structure, and associated piping and valves. These analyses are currently being performed by NES.

As can be seen from the above discussion, DPC had started its own program of seismic/structural evaluations long before August 4, 1980 (Technical Reference 8) and in some cases even before the Systematic Evaluation Program began.

Summarizing this work to date:

1. Integrity of the reactor coolant pressure boundary: Structural analyses have been completed for the reactor pressure vessel, the main steam piping, the feedwater piping, and the recirculation piping.

2. Integrity of fluid and electrical distribution systems related to safe shutdown and engineered safety features: Structural analyses have been completed for the high pressure core spray suction and discharge piping. Analysis of the alternate core spray piping and shutdown condenser piping is currently in progress. Seismic pipe restraints for the high pressure core spray piping are currently being designed and fabricated for installation commencing early in November 1980 during the next scheduled refueling outage.

3. Integrity and functionability of mechanical and electrical equipment and engineered safety feature systems: Structural analyses of the Containment Building steel shell, outer shield wall, inner shield wall, concrete foundation and pile foundation is complete. Analysis of the LACBWR stack is complete. Analysis of the shutdown condenser and associated equipment is in progress.

As stated earlier, the previous analytical work performed for several major LACBWR piping systems indicated the need for additional pipe restraints. Since this work has been completed ahead of the Systematic Evaluation Program schedule, DPC has committed to a fabrication and installation program for the pipe restraints. DPC prefers to undertake this program now rather than wait for a 1982 outage, as proposed in Technical Reference 8. DPC has taken this position with the assumption that the ground response spectra shown in Technical Reference 8 is substantially correct and will not be revised in a more conservative direction by the NRC. It is estimated that an additional 24 months of analytical and evaluative work remain to satisfy the requests provided in your letter. This time table appears consistent with the progress of the Systematic Evaluation Program and the review of the Full Term Operating License.

Technical Reference 10 states that the NRC has determined that "the return period for an earthquake resulting in a peak acceleration of .12G would be at least 1,000 years and that the actual return period could be an order of magnitude higher. The LACBWR site is located in the Central Stable Region where historically the seismic activity is very low. Using seismicity data developed by the TERA Corporation for Lawrance Livermore Laboratory and the NRC, in conjunction with a computer program designed to perform seismic risk analysis, Dames & Moore has determined that the return period for an earthquake of this size is at least 10,000 years and more likely between 10,000 and 100,000 years."

Since the duration of the structural/seismic portion of the SEP is much shorter than the anticipated remaining life of the plant and since both DPC and NRC have agreed that the general level of seismic hazard is sufficiently low for LACBWR's anticipated remaining life, DPC feels continued operation of LACBWR is justified in the interim until the Systematic Evaluation Program is complete.

If there are any questions concerning this submittal, please contact us.

Very truly yours,

DAIRYLAND POWER COOPERATIVE

Frank Linder

Frank Linder, General Manager

FL:RES:af

Enclosures

cc: J. G. Keppler, Reg. Dir., NRC-DRO III
NRC Resident Inspectors

Technical References:

1. Gulf United Report No. SS-1162, Seismic Evaluation of the La Crosse Boiling Water Reactor, January 1974; DPC Letter, Madgett to Giambusso, LAC-2788, dated October 9, 1974 (Application for FTOL).

*2. NES 81A0089, Seismic and Stress Analysis of LACBWR Recirculation Piping System.

*3. NES 81A0088, Seismic and Stress Analysis of LACBWR Main Steam Piping System.

*4. NES 81A0087, Seismic and Stress Analysis of LACBWR Feedwater Piping System.

*5. NES 81A0090, Seismic and Stress Analysis of LACBWR High Pressure Core Spray Suction Line Piping System.

*6. NES 81A0091, Seismic and Stress Analysis of High Pressure Core Spray Discharge Line Piping System.

7. NES 81A0092, Seismic and Structural Analysis of LACBWR and Genoa 3 Stacks, June 1976.

8. NRC Letter, D. G. Eisenhut to F. Linder, SEP Structural/ Seismic Evaluations, August 4, 1980.

9. NES Letters 5101-382, 5101-420, and 5101-481, R. A. Milos to R. E. Shimshak, Systematic Evaluation Program, Seismic and Structural Analysis, dated 9/7/78, 10/24/78 and 3/22/79 respectively (Transmitted with this letter).

10. Licensee's Answer to Order to Show Cause, dated March 25, 1980.

---

* DPC Letter, Linder to Director NRR, LAC-5478, dated September 27, 1978.

NUCLEAR ENERGY SERVICES, INC.
NES DIVISION
SHELTER ROCK ROAD
DANBURY, CONN. 06810
(203) 748-3561

September 7, 1978
Reference No. 5101-382

Mr. Richard E. Shimshak
LaCrosse Boiling Water Reactor
Dairyland Power Cooperative
P.O. Box 135
Genoa, WI 54632

Subject: Systematic Evaluation Program
Seismic Analysis Flow Chart

Dear Mr. Shimshak:

Enclosed is the SEP - Seismic Analysis Flow Chart, which we discussed last week at LACBWR. Confirming our telephone conversation today, Iqbal Husain is preparing a Task Plan covering the SEP - seismic analyses work and, in accordance with your instructions, he has started to model the Containment Building.

If we can be of further assistance, please call.

Very truly yours,

NUCLEAR ENERGY SERVICES, INC.
NES Division

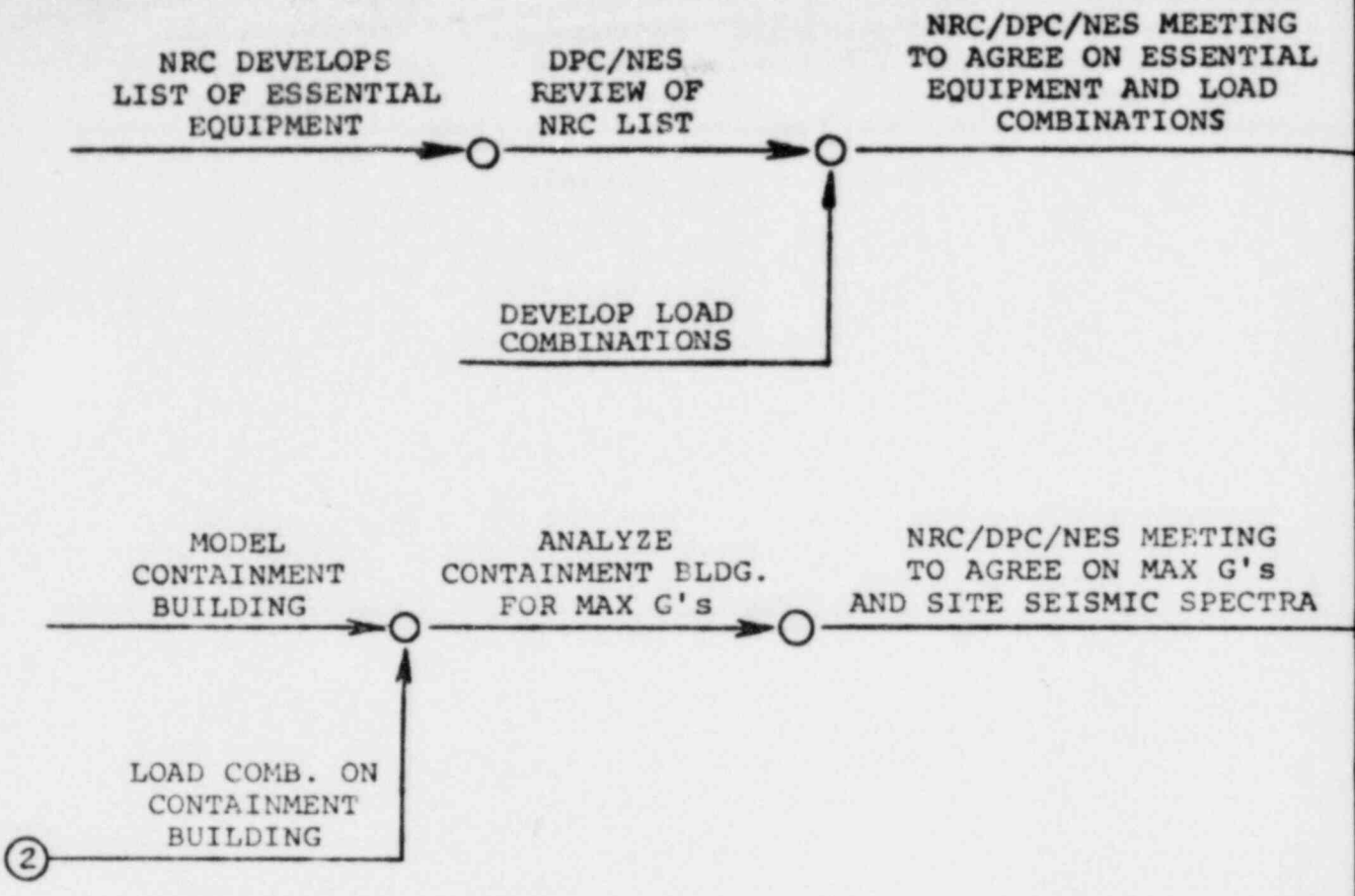
Richard Milos

Richard A. Milos
Project Manager

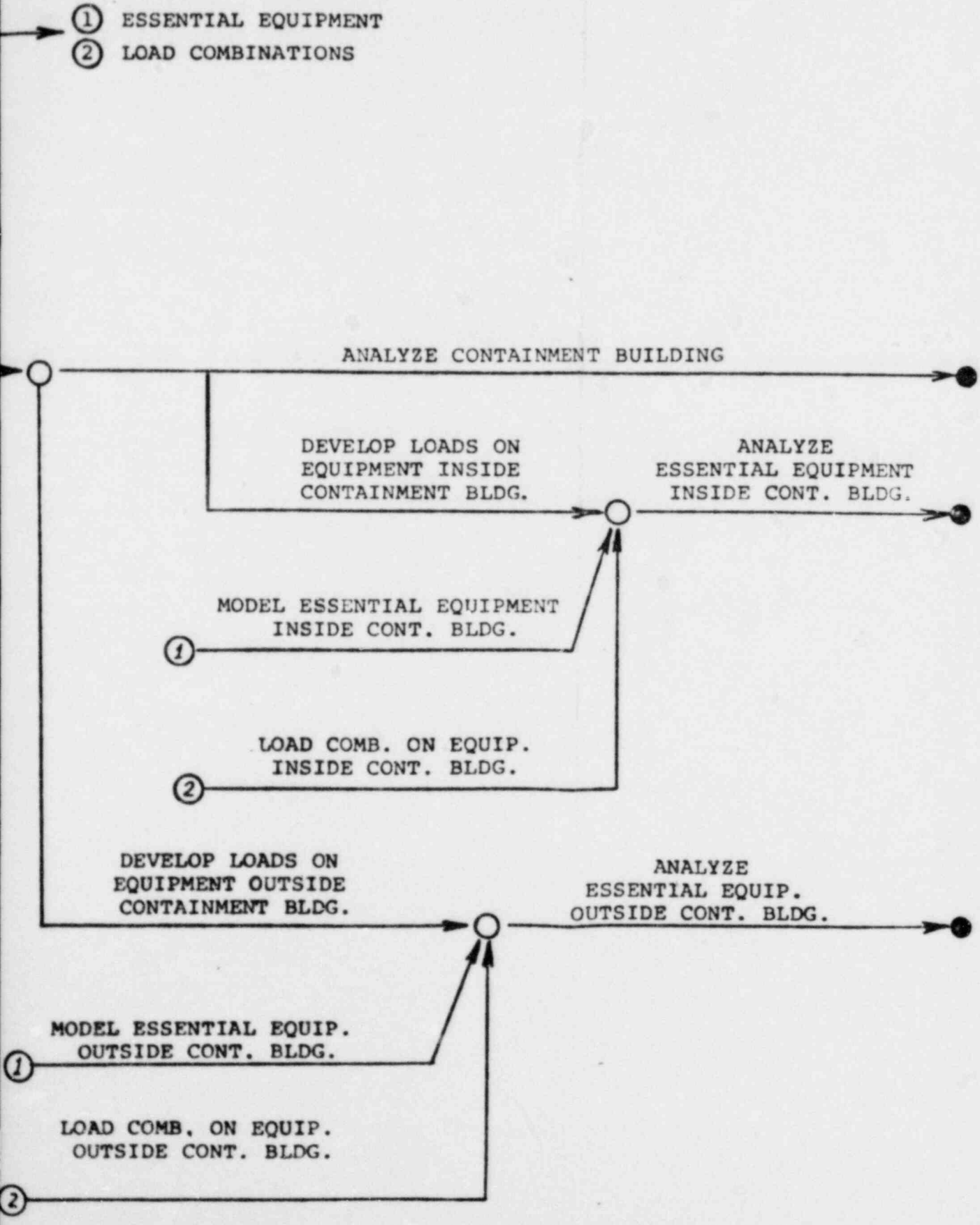
RAM/las
Enclosure

cc W. J. Manion
A. H. Yoli
I. Husain

Copies: J. Parker.
M. Harfast
NES


NRC DEVELOPS LIST OF ESSENTIAL EQUIPMENT
DPC/NES REVIEW OF NRC LIST
NRC/DPC/NES MEETING TO AGREE ON ESSENTIAL EQUIPMENT AND LOAD COMBINATIONS
DEVELOP LOAD COMBINATIONS
MODEL CONTAINMENT BUILDING
ANALYZE CONTAINMENT BLDG. FOR MAX G's
NRC/DPC/NES MEETING TO AGREE ON MAX G's AND SITE SEISMIC SPECTRA
LOAD COMB. ON CONTAINMENT BUILDING
2

SEP - SEISMIC ANALYSES FLOW CHART



NUCLEAR ENERGY SERVICES, INC.
NES DIVISION
SHELTER ROCK ROAD
DANBURY, CONN. 06810
(203) 748-3581

R. Shimshak
RECD NOV - 2 1978
NES

October 24, 1978
Reference No. 5101-420

Mr. Richard E. Shimshak
Dairyland Power Cooperative
La Crosse Boiling Water Reactor
P.O. Box 135
Genoa, WI 54632

Subject: Task Plan for the LACBWR-SEP
Seismic and Structural Analysis

Dear Mr. Shimshak:

Enclosed is the Task Plan for the Seismic and Structural Evaluation of Major Building Structures, Equipment, Piping Systems and Components for the LACBWR Systematic Evaluation Program. Please review the enclosed Task Plan and send us your approval and/or comments.

If there are any questions, please do not hesitate to call.

Very truly yours,

NUCLEAR ENERGY SERVICES, INC.
NES Division

Richard Milos

Richard A. Milos
Project Manager

RAM/jam

Enclosure

cc: J. D. Parkyn
W. J. Manion
A. H. Yoli

Copies: Shimshak
NES Rdg. File
Parkyn
Seifert
Tomlinson
[illegible]

TASK PLAN

FOR

SEISMIC AND STRUCTURAL EVALUATION OF MAJOR BUILDING STRUCTURES, EQUIPMENT, PIPING SYSTEMS AND COMPONENTS FOR THE LACBWR SYSTEMATIC EVAL''ATION PROGRAM

PREPARED UNDER PROJECT 5101

FOR

DAIRYLAND POWER COOPERATIVE

NUCLEAR ENERGY SERVICES, INC.
DANBURY, CONNECTICUT 06810

A. Objective

To perform seismic and structural analyses of essential building structures, equipment, piping systems and components for the LACBWR Systematic Evaluation Program.

B. Background

USNRC has initiated the Systematic Evaluation Program (SEP) for a number of older nuclear power plants. La Crosse Boiling Water Reactor is one of these plants. In the SEP it is required that essential building structures, equipment, piping systems and components be evaluated to verify their adequacy to withstand the normal loads (e.g. dead, live, pressure and thermal loads) as well as the loads associated with seismic and LOCA events. In an earlier response to the AEC/DL's request to review the effects of an earthquake event on LACBWR, Dairyland Power Cooperative requested Gulf United Nuclear Fuels Corporation to evaluate the adequacy of the major structures and equipment to withstand seismic loadings. The Gulf United (GU) Nuclear Fuels Corporation study used the ground response spectra (developed by Dames and Moore) which was based on a maximum horizontal ground acceleration of 0.12 G for the Safe Shutdown Earthquake (SSE). The Gulf United Study (Reference 1) indicated that high stresses would be generated in some piping systems (e.g. main steam) and building structures (e.g. the LACBWR stack) during a seismic event. To eliminate the possibility of a seismically induced loss of coolant accident, detailed seismic/stress analyses of the major LACBWR piping systems were subsequently performed and the design of necessary seismic support systems were initiated by NES (References 2 through 6).

In the SEP, however, NRC is asking LACBWR to evaluate the plant adequacy for a higher seismic input ground motion (>.12G) and to include the effects of other loads (dead, live, pressure, thermal, etc.) which were not considered in the GU study. Therefore some of the seismic/structural analysis work will have to be redone or modified.

NES proposes to perform the SEP seismic/structural analyses work in accordance with the flow chart shown on Figure 1 and the method of approach described in Section C of this task plan.

C. Method of Approach

As indicated on the seismic/structural analyses flow chart, on receiving the list of essential equipment (which is being developed by NRC), NES will prepare the applicable loads, load combinations and the corresponding structural acceptance criteria

for each item of essential equipment. These loads, load combinations and the corresponding structural acceptance criteria will be based on the guidelines given in NRC Standard Review Plan Section 3.8.4 (Reference 7), applicable ASME, AISC and ACI codes (References 13 through 15) and current nuclear industry practice. The list of essential equipment, loads, load combinations and acceptance criteria will be reviewed and agreed on by NRC/DPC/NES prior to performing any detail analysis work.

NRC and their consultant Lawrence Livermore Laboratory (LLL) are currently reviewing the regional geological, seismological information and the LACBWR site soil data. NRC has requested the maximum seismic loading that the plant structure could withstand without making major structural modifications. This information along with the LLL recommendations will be used by NRC in developing the maximum ground acceleration and the site seismic spectra.

Since major modifications to the containment building would be very costly and would involve an extended shutdown, NES believes that it is the most important essential structure to analyze with respect to establishing the maximum tolerable seismic loading. Furthermore, the seismic response results of the containment building are required in evaluating the structural adequacy of other essential equipment, NES is currently developing the mathematical model for the seismic analysis of the containment building. The multi-degree of freedom lumped mass finite element mathematical model of the containment building is based on current industry practice and includes the soil structure interaction effects as well as that of the pile foundation: the seismic analysis will be performed using ground acceleration time history input base motion and the modal superposition methods of dynamic analysis. The characteristics of the base motion time history will be such that its spectra will envelope the ground response spectra given in NRC Regulatory Guide 1.60 (Reference 8). Appropriate damping values given in NRC Regulatory Guide 1.61 (Reference 9) will be used in the analysis. The effect of each of the three orthogonal spatial components (two horizontal and one vertical) of the earthquake will be based on procedure given in NRC regulatory Guide 1.92 (Reference 10).

The containment building structures will also be analyzed for other normal (dead and live loads) and abnormal loading conditions (pressure and thermal loads of LOCA) using appropriate finite element models and static or dynamic methods of structural analysis.

The response results of the seismic normal and abnormal loading conditions will be combined and compared with the allowable values in accordance with NRC standard review plan 3.8.4. The mathematical model, load combinations, analytical methodology, etc will be reviewed with DPC/NRC prior to performing the detail analyses work. From the above analyses the maximum ground

acceleration that the plant could withstand without making major structural modifications to the containment building will be developed.

Based upon this DPC determined maximum ground acceleration value, LLL recommendations and NRC experience with other utilities participating in the SEP, NRC will select the maximum ground acceleration and site seismic spectra as indicated in the flow chart.

If major plant structural modifications are required to meet the NRC seismic criteria using conventional seismic analysis methods, NES will perform non-linear time history seismic analyses to take advantage of the additional material strength (reserve energy) available in the plastic range. Also wherever feasible probalitic combination of various loadings will be considered.

As indicated in the seismic analyses flow chart, mathematical models, load combinations, structural acceptance criteria, etc. will be similarly developed for essential equipment. These equipment and essential systems will be evaluated to verify their adequacy to survive and seismic and/or a LOCA event by using appropriate analytical methods, available environmental test results for similar equipment and/or in sites vibration testing. In the analytical methods, the floor response spectra or floor response time history results from the containment building seismic analysis will be used as input seismic motion. Information (models, input data, etc.) available from prior GU study and NES analyses work (Reference 1 through 6) will be utilized to reduce the effort required in the SEP analysis work. The seismic and structural analyses will be performed using STARDYNE, ANSYS and PIPESD computer codes (References 16 through 18).

D. Workscope

Since the SEP seismic/structural analysis work is quite extensive, the workscope for the analysis of each individual building structure, equipment, and piping system will be furnished to DPC prior to starting the detail analysis work.

The workscope for the seismic/structural evaluation of the containment building which is being performed by NES is given below:

1. Prepare lumped mass mathematical of the containment building including soil structure interaction effects.

2. Develop member properties, lumped masses and base input motion

3. Perform seismic analysis.

4. Prepare finite element models of the containment building to evaluate the effects of other normal and abnormal loadings.

5. Prepare stiffness properties and input data for the normal and abnormal loading conditions.

6. Perform appropriate static/dynamic analysis of the finite element models.

7. Evaluate the effects of the combined seismic and other normal/abnormal loading conditions on the overall containment building structures and on the local critical areas such as pile foundation, containment to foundation interface, opening for the personnel lock, overhead tank, crane to support column, reactor vessel to pedestal connection, etc.

8. Develop the acceptable maximum horizontal ground acceleration values.

9. Prepare the detail analysis report.

E. Task Engineer

I. Husain will be Task Engineer for this workscope.

G. Schedule

The workscope items will be completed within five months.

H. References

1. GUS Report No. SS-1162, Seismic Evaluation of the LaCrosse Boiling Water Reactor

2. NES 81A0089, Seismic and Stress Analysis of LACBWR Recirculation Piping System.

3. NES 81A0038, Seismic and Stress Analysis of LACBWR Main Steam Piping System

4. NES 81A0087, Seismic and Stress Analysis of LACBWR Feedwater Piping System.

5. NES 81A0090, Seismic and Stress Analysis of LACBWR High Pressure Core Spray Suction Line Piping System.

6. NES 81A0091, Seismic and Stress Analysis of High Pressure Core Spray Discharge Line Piping System.

7. USNRC Standard Review Plan, Section 3.8.4.

8. USNRC Regulatory Guide 1.60 "Design Response Spectra for Seismic Design of Nuclear Power Plants" Rev. 1, December 1973.

9. USNRC Regulatory Guide 1.61, "Damping Values for Seismic Design of Nuclear Power Plants", October 1973.

10. USNRC Regulatory Guide 1.92, "Combination of Modes and Spatial Components in Seismic Response Analysis", Rev. 1, February, 1976.

11. USNRC Regulatory Guide 1.122 "Development of Floor Design Response Spectra for Seismic Design of Floor-Supported Equipment or Components", September 1976.

12. USNRC Regulatory Guide 1.57 "Design Limits and Loading Combinations for Metal Primary Reactor Containment System Components", June 1973.

13. ASME Boiler and Pressure Vessel Code, Section III, Division 1, 1974 Edition, Nuclear Power Plant Components.

14. "AISC, Steel Construction Manual", American Institute of Steel Construction, Inc., New York, Seventh Edition, 1970.

15. "Building Code Requirements for Reinforced Concrete (ACI 318-71)", American Concrete Institute, March 1973.

16. MRI/STARDYNE 3 - Static and Dynamic Structural Analysis Systems for Scope 3.4 Operating System User's Information Manual, Revision A, Control Data Corporation, August, 1976.

17. Swanson Analysis, Inc., "ANSYS - Engineering Analysis System User Information Manual", Revision D, Control Data Corporation, March, 1976.

18. URS/John A. Blume and Associates - "PIPESD" - Pipe Static, Dynamic and Thermal Transient Analysis System, Version 5.1, Revision F, Control Data Corporation, December 1977.

SEP - SEISMIC ANALYSES FLOW CHART

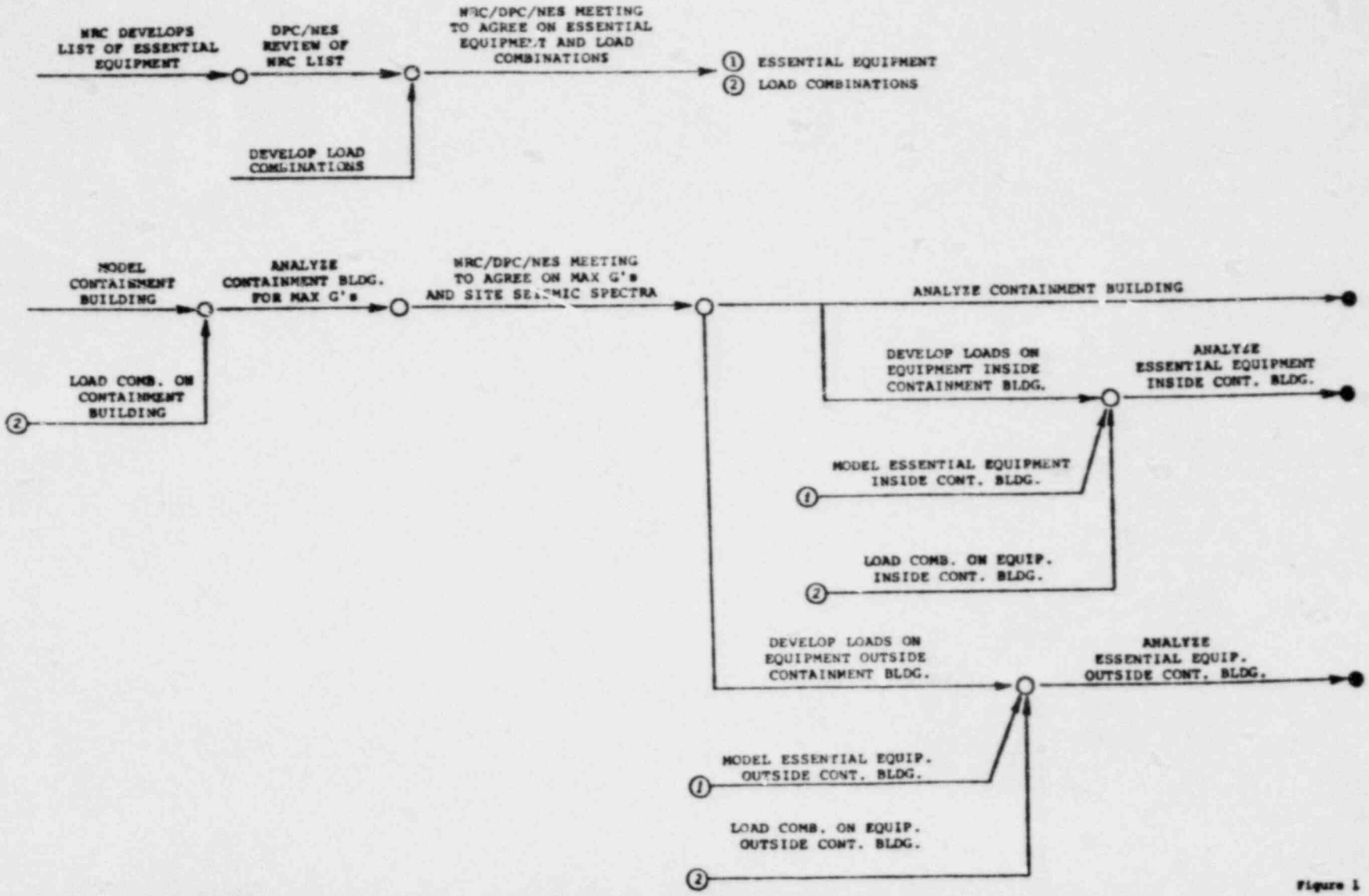


Figure 1

R. Shimshak
RECD MAR 26 1979

NUCLEAR ENERGY SERVICES, INC.
NES DIVISION
SHELTER ROCK ROAD
DANBURY, CONN. 06810
(203) 748-3581

NES notebook

Mr.Richard E. Shimshak
LaCrosse Boiling Water Reactor
Dairyland POwer Cooperative
P.O. Box 135
Genoa, Wi. 54632

March 22, 1979
Project/Task No.: 5101
Reference No.: 5101-481

Subject: SEP - Seismic and Structural Analysis

Reference: Telecon between R. E. Shimshak and R. A. Milos, Same Subject, on March 20, 1979

Dear Mr. Shimshak:

Enclosed is the revised SEP - Seismic Analysis Flow Chart which you requested in the referenced telecon. This flow chart was revised to indicate completion dates for the containment building model, the containment steel shell analysis and the complete containment building analysis to determine the maximum seismic loads which the containment building can survive. The flow chart also indicates the time intervals to complete other specific analyses, which will be required after the site specific spectra have been established and agreed to by DPC and NRC.

Enclosed also is a copy of the SEP - seismic and structural analyses Task Plan which was sent to you on October 24, 1978 with letter 5101-420.

If we can be of further assistance, please call.

Very truly yours,

NUCLEAR ENERGY SERVICES, INC.
NES Division

Richard Milos

Richard A. Milos
Project Manager

RAM:ma
Enc.

cc: W. J. Manion
A. H. Yoli
I. Husain

Copy
NES Bldg. ...
R. Shimshak
...

SEP - SEISMIC ANALYSES FLOW CHART

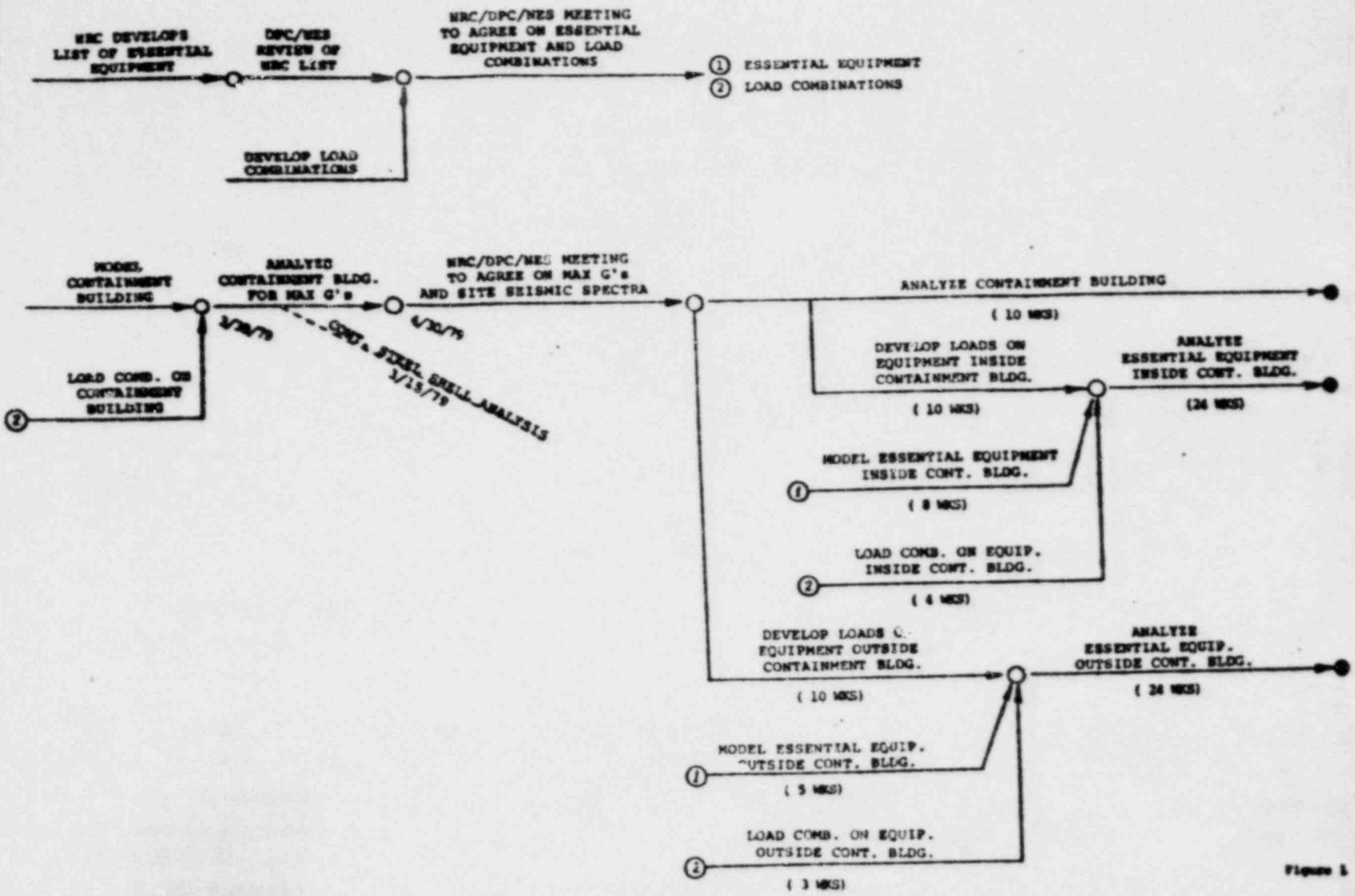


Figure 1