STANDARD FORM 30 JULY 1966
GENERAL SERVICES ADMINISTRATION

AMENDMENT OF SOLICITATION/MODIFICATION OF CONTRACT

1

1. AMENDMENT/MODIFICATION NO.: M.O.D. (2)
2. EFFECTIVE DATE: 12/3/80
3. REQUISITION/PURCHASE REQUEST NO.: RES-79-203 dtd. 11/21/80
4. PROJECT NO. (If applicable):

5. ISSUED BY — CODE:
6. ADMINISTERED BY (If other than block 5) — CODE:

U. S. Nuclear Regulatory Commission
Division of Contracts
Washington, DC 20555

7. CONTRACTOR NAME AND ADDRESS — CODE — FACILITY CODE
(Street, city, county, state, and ZIP Code)

ANCO Engineers, Incorporated
1701 Colorado Avenue
Santa Monica, CA 90404

8. ☐ AMENDMENT OF SOLICITATION NO. ____
DATED ____ (See block 9)
☒ MODIFICATION OF CONTRACT/ORDER NO. NRC-04-79-203
DATED 9/17/79 (See block 11)

9. THIS BLOCK APPLIES ONLY TO AMENDMENTS OF SOLICITATIONS

☐ The above numbered solicitation is amended as set forth in block 12. The hour and date specified for receipt of Offers ☐ is extended, ☐ is not extended.

Offerors must acknowledge receipt of this amendment prior to the hour and date specified in the solicitation, or as amended, by one of the following methods:
(a) By signing and returning ____ copies of this amendment; (b) By acknowledging receipt of this amendment on each copy of the offer submitted; or (c) By separate letter or telegram which includes a reference to the solicitation and amendment numbers. FAILURE OF YOUR ACKNOWLEDGEMENT TO BE RECEIVED AT THE ISSUING OFFICE PRIOR TO THE HOUR AND DATE SPECIFIED MAY RESULT IN REJECTION OF YOUR OFFER. If, by virtue of this amendment you desire to change an offer already submitted, such change may be made by telegram or letter, provided such telegram or letter makes reference to the solicitation and this amendment, and is received prior to the opening hour and date specified.

10. ACCOUNTING AND APPROPRIATION DATA (If required)

B&R NO. 60-19-01-30 FIN NO. B6758 $99,332.00

11. THIS BLOCK APPLIES ONLY TO MODIFICATIONS OF CONTRACTS/ORDERS

(a) ☐ This Change Order is issued pursuant to ____
The Changes set forth in block 12 are made to the above numbered contract/order.
(b) ☐ The above numbered contract/order is modified to reflect the administrative changes (such as changes in paying office, appropriation data, etc.) set forth in block 12.
(c) ☒ This Supplemental Agreement is entered into pursuant to authority of mutual agreement of the parties
It modifies the above numbered contract as set forth in block 12.

12. DESCRIPTION OF AMENDMENT/MODIFICATION

Under Article III - Consideration, paragraph 2, the total funds available for payment and allotted to this contract are increased by $99,332.00 from "$149,630.00" to "$248,962.00". Also in paragraph 2, the amount "$139,191.00" is deleted and replaced by "$229,493.00" and the amount "$10,439.00" is deleted and replaced by "$19,469.00."

Under Article I, Statement of Work, Task II, the following is added:

Task II - A URL Piping System

The first series of proposed tasks involves simulations of the URL piping system motion for explosive and snapback loading. The main thrust of these tasks is to modify the URL analytical model so as to match the data obtained from the explosive and snapback tests at HDR during 1979. Attention will also be given to the input excitation to the ANSYS model.

Except as provided herein, all terms and conditions of the document referenced in block 8, as heretofore changed, remain unchanged and in full force and effect.

13. ☐ CONTRACTOR/OFFEROR IS NOT REQUIRED TO SIGN THIS DOCUMENT ☒ CONTRACTOR/OFFEROR IS REQUIRED TO SIGN THIS DOCUMENT AND RETURN 4 COPIES TO ISSUING OFFICE

14. NAME OF CONTRACTOR/OFFEROR
BY ____ (Signature of person authorized to sign)

17. UNITED STATES OF AMERICA
BY ____ (Signature of Contracting Officer)

15. NAME AND TITLE OF SIGNER (Type or print)
16. DATE SIGNED
18. NAME OF CONTRACTING OFFICER (Type or print): Kellogg V. Morton
19. DATE SIGNED

Task II A.1 Detailed Study of the Models of the Pipe Support Devices

It is proposed to simulate the static and dynamic behavior of each pipe support individually (spring hanger, sway brace, and constant force device). The computer program ANSYS will be used to do this. Also, parameter identification will be used to adjust the constants defining the models of the supports so that the support static data can be reproduced as closely as possible. The damping characteristics of the supports will also be matched. Nonlinear properties will be investigated.

Task II A.2 Refinement of Pipe Outside Diameter and Wall Thickness Values

There has been some question as to the variance of the outside diameter and wall thickness of the URL piping system. It is proposed to obtain more accurate values of the pipe O.D. and wall thickness, and implement these in the URL model. This data is currently becoming available from KFK.

Task II A.3 Refinement of URL Room Base Motion Input to Include Rotations

It was concluded in a progress report to the NRC (ANCO Report 1182-8, April 1980) that the torsional motion of the containment affected the base motion of the URL room somewhat. It is proposed to determine the URL room base motion as a function of the translation of a point in the room and the rotation. The translation and rotation would be determined from kinematics. From the absolute acceleration at two points, and kinematics, the translation and rotation can be determined. From this, the acceleration of any point in the room can be determined. This would be done for the data for some pairs of points, and the acceleration at the remaining points would be calculated and compared with the data for those points; i.e., from the data at points 1 and 4, determine the acceleration at points 2 and 3, and compare with the data for points 2 and 3. This would be done for various pairs of points, and the "best" values for the translation and rotation as a function of time would be determined. It would be determined how closely the URL room behaved as a rigid body.

Task II A.4 Refinement of the Snapback Release Force Induced by the Hydraulic Snapper

In conducting the snapback tests of the URL system at HDR, a hydraulic ram was used to *push* the pipe to a statically deformed position. A snapback test was initiated by rapidly decreasing the oil pressure in the hydraulic system, thus causing the force the ram exerted on the pipe to go rapidly to zero. As the pipe pushed the ram back (pipe velocity increased), the hydraulic fluid was pushed through the ram orifice, resulting in, after a very short time, an increasing ram force on the pipe. The pipe continued to push the ram backwards until its velocity was zero; then the pipe lifted off the ram. It is proposed to model the hydraulic ram force on the pipe during this portion of the snapback event. This would involve limited testing of the ram to determine the form of its forcing function for this type of loading. Parameter identification would be used to approximately determine the forcing function corresponding to the snapback tests being looked at.

Task II A.5 Parameter Identification

Tasks 1.1 and 1.4 call for the use of parameter identification (PID). Existing and working programs NONBAY and NONBAYI will be used. A limited amount of program improvement will be performed to support previous tasks. Identification using static and strain measurements will be investigated as well.

Task II A.6 Evaluation of Damping Under Different Excitation Type and Response Level

Task 1.6 will determine the damping in the URL as a function of excitation type (sinusoidal, snapback, blast) and response level in hot and cold condition. This would help justify damping estimates and test methods. Also, this task will re-evaluate, in retrospect, optimal testing methods for nuclear power plant seismic upgrading.

Task II B Containment Rocket Tests

The 1979 tests at HDR included pulse loading tests of [illegible] structure. The technique involved attaching solid propellant rockets to the outside of the containment building near the intersection of the hemi-spherical cap with the vertical cylinder comprising the containment. The duration of the rocket pulse was approximately 0.5 seconds. The data from the test indicated a substantial amount of ovalling motion of the containment. ANCO suggests examining the shell modes due to the local rocket loading (useful for aircraft/turbine missile impact analysis) and comparing this experimental data to analytical results.

Task II C Flood Water Storage Tank Tests

Forced vibration (harmonic forcing) tests of the flood water storage tank (FWB) at HDR were performed during the 1979 tests. The tank is a large cylindrical steel vessel approximately 15 meters in height and 2.5 meters in diameter. The tank is free standing and is supported at its base by a system of I-Beam. The tank was filled with water during the tests. This tank is typical of liquid storage tanks used in nuclear power plants. ANCO has data available on other tanks at other power plants, (i.e., Diablo Canyon Nuclear Power Plant and Humboldt Bay).

The design of this type of tank involves, as a critical aspect, the method by which it is anchored to a base, usually a floor. This is usually done using a metal cylindrical skirt welded to the bottom of the tank at one end and bolted to the floor at the other. Critical items are possible buckling of the skirt and breaking of the anchor bolts.

It is proposed to study the data from the FWB tests and other ANCO data, along with performing computer model simulations of the FWB response, in an attempt to increase understanding of the behavior of tank supports while under seismic loading. This will lead to more realistic tank modeling methods.

Task III [illegible] URL Piping Response to Dynamic Loads from Valve and Rupture Disk Sources

Various valve/rupture disk tests of the URL piping system [illegible] have been performed, and data on support loads, pipe strains and motion of the piping system was obtained. Using the previously identified structural model of the URL system (Task 1), a model(s) of the dynamic loading phenomena, this test data, and a parameter identification process, the URL model response can be made to "fit" the data.

During the parameter identification process, the parameters defining the structural model are not varied, but the parameters defining the dynamic loading phenomena are varied. By varying the blowdown parameters, the URL structural model response can be made to "fit" the response data. How much the hydraulic parameters have to be changed to obtain the "fit" is a measure of the accuracy of the blowdown model(s). Of course, there will be inaccuracies in the structural model, but it will be a best "fit" model and the amount of inaccuracy known. From this, the approximate amount of error in the blowdown simulation can be determined.

Studying what blowdown parameter changes are made in the "fit" process would help increase understanding about the blowdown process. It would also provide an opportunity to check various thermal hydraulic codes against each other.

Another approach to studying the blowdown phenomena is to use force identification. This involves developing a test justified piping dynamic model (done in Task 1), performing blowdown tests to obtain system response (already done by West Germans), and then determining the required force input to the structural model necessary to obtain a match between model response and test data (force identification). The forces obtained are then compared with those predicted by thermal hydraulic codes. This work is also proposed as part of this task.

IMAGE EVALUATION
TEST TARGET (MT-3)

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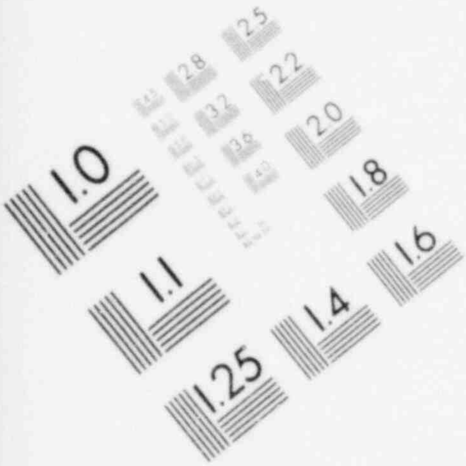


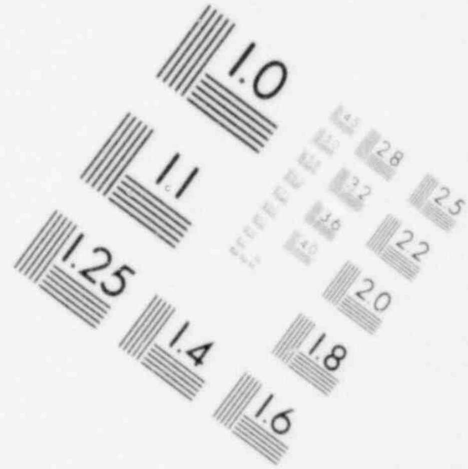
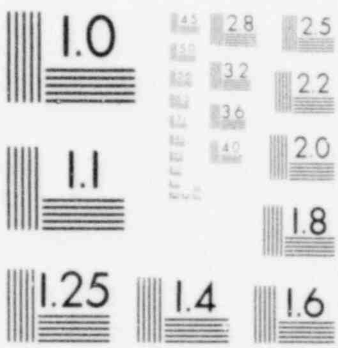


IMAGE EVALUATION TEST TARGET (MT-3)



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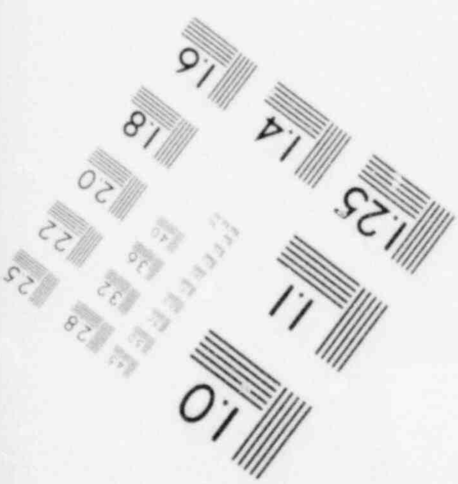

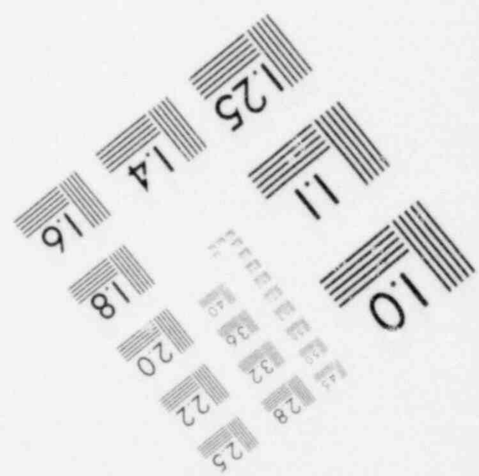

Task II E   Comparison of Different Analysis Methods

A major area of interest (Task E) is to review the comparisons between various analytical models and the test results. Calculations have been made using several dozen different methods (finite element, lumped mass, shell models, etc.) and using the services of various types of consultants and computer programs. KFK's DOSYS system for documentation permits a ready comparison between theory and experiment. Some limited comparisons have been carried out by Battelle and KFK. It would be extremely useful to compare these results independently, particularly with emphasis on implications for U.S. design practices and regulations.

Task II F   System Identification of Containment Structure

The intermediate level test program at HDR included exciting the containment structure with large eccentric mass vibrators capable of delivering 250,000 lbs (10^6 Newtons) of force. Response levels on the order of .10 g's were achieved on the operating floor. The global resonance frequencies of the structure and corresponding mode shapes, and values of critical damping from 0-20 Hz were identified. The data is of very high quality and includes results over a wide range of applied force levels. The data is ideal for system identification applications.

During the former low level tests at HDR, ANCO undertook a system identification study to match the test results to a finite element model of the structure using a Bayesian system identification scheme. This analysis was moderately successful in that the two-dimensional model was adjusted to duplicate test results for the first four translational modes.

Torsional modes and higher order bending modes were not addressed.

ANCO is currently developing a system identification code that is a finite element computer code with a built-in capability to perform a system identification from the results of a forced vibration test using eccentric mass vibrators. The code is viewed as a significant advancement in the current state-of-the-art. It will be ready for practical use by January 1981.

ANCO would therefore propose to use the test results from the intermediate level tests on the containment structure and the basic finite element model of the structure resulting from the previous study, and to perform another system identification of the containment structure. The new system identification would address the following:

- Extend the study from a two-dimensional finite element mode to a three dimensional finite model to include torsional modes.
- Use the ANCO finite element system identification code.
- Match the higher order modes of the structure.
- Study the effects of applied force level on fundamental mode shifts in resonance frequency and values of critical damping.
- Assess the methodology in general, and make conclusions regarding the practical implementation of this technique specifically.

Recently there has been some thought in the nuclear regulatory agencies of many countries to validate structural models via some kind of test program as part of the licensing process for the nuclear facilities. The Japanese government has recently invested heavily in this concept. It is felt that a study of this nature would serve to address the practical application and implementation of using test results to verify analyses and suggest modifications to analyses by system identification techniques.

Under Article I, Paragraph C, Report Requirements, the following is added:

Task Reports

At the conclusion of each subtask under the contract, the Contractor shall submit a formal Task Report in draft form in one (1) copy to the Project Officer. Within 30 days, the Project Officer will provide comments and/or verbal approval.

Within 15 days of approval of the draft, the Contractor shall submit in one (1) reproducible and five (1) copies to the Project Officer and one (1) copy to the Contracting Officer.

Each Task Report shall as a minimum, document the effort accomplished and summarize the resulting conclusions and recommendations.

Yearly Final Reports

The Contractor shall submit a yearly formal report summarizing conclusions and recommendations made to date.

Note: A yearly report shall be due on the first year's effort within thirty days of execution of this modification.

As a minimum, the Yearly Report shall address:

1. the objectives of the research;
2. the approach or methodology used to obtain the results;
3. interpretations of the results;
4. conclusions and recommendations;
5. limitations of findings;
6. potential impact on safety;
7. problem areas;
8. any other areas the Contractor feels are significant.

Annual Light Water Reactor Safety Information Meeting

The Contractor shall prepare and deliver a presentation at the Annual Light Water Reactor Safety Information Meeting at the NBS in Gaithersburg, Maryland.