HOLTEC INTERNATIONAL

Holtec Center, 555 Lincoln Drive West, Marlton, NJ 08053
Telephone (856) 797-0900
Fax (856) 797 - 0909

DIABLO CANYON ISFSI SITE BOUNDARY CONFINEMENT ANALYSIS

FOR

PACIFIC GAS AND ELECTRIC

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Summary of Revisions

Revision 1:

Due to changes in the ISFSI layout the minimum distance to the controlled area boundary has changed from 1325 feet to 1400 feet. The χ/Q value provided by Diablo Canyon is a conservative value for both 1325 and 1400 feet. The revisions to this document are strictly editorial to indicate the change in the minimum distance to the controlled area boundary.

Revision 2:

Changes to the ISFSI layout has increased the maximum number of casks in the ISFSI from 138 to 140. This revision reflects that change to the doses due to an effluent release under normal and off-normal conditions. Additionally, this revision adds the letter relating these changes and changes to the previous revision to Appendix B and the list of references.

Revision 3:

In Section 3.0 changed 25 rem to 25 mrem in the second paragraph. Clarified that the χ/Q value provided by Diablo Canyon is conservative and applicable for a distance of 1400 feet.

Revision 4:

Revised the doses due to inhalation to reflect changes in the DCFs for inhalation. These changes were instituted in response to an RAI from the NRC on the HI-STORM FSAR License Amendment Request (LAR 1014-1).

The equations used in Appendix A are added to the first page of Appendix A.

Table 9-1 and Table 9-2 have been revised to reflect the changes above.

Table of Contents

1.0 Introduction

This analysis is to demonstrate that radiological releases to the environment resulting from a confinement breach from the Diablo Canyon ISFSI will be within regulatory limits specified in 10CFR72 [1]. This confinement analysis addresses normal, off-normal and accident conditions of storage. The results from this confinement analysis are an extension of the results presented in Chapter 7 of the Final Safety Analysis Report (FSAR) for the HI-STORM [2,19] System, applied to the Diablo Canyon site.

This report is prepared pursuant to the provisions in Holtec Quality Procedures HQP 3.0 and 3.2, which require that all analyses utilized in support of the design of a safety-related or important-to-safety structure, component, or system be fully documented such that the analyses can be reproduced at any time in the future by a specialist trained in the discipline(s) involved. HQP 3.2 sets down a rigid format structure for the content and organization of calculation packages that are intended to create a document that is complete in terms of the exhaustiveness of content. The calculation packages, however, lack the narrational smoothness of a technical report, and are not intended to serve as a technical report.

Because of its function as a repository of all analyses performed on the subject of its scope, this document will require a revision only if an error is discovered in the computations or if the equipment design is modified. Additional analysis in the future may be added as numbered supplements to this package. Each time a supplement is added or the existing material is revised, the revision status of this package is advanced to the next number and the Table of Contents is amended. Calculation packages are Holtec proprietary documents. They are shared with a client only under strict controls on their use and dissemination.

This calculation package will be saved as a permanent record under the company's QA program.

The HI-STORM System is comprised of two main components, the Multi-Purpose Canister (MPC) and the overpack. The fuel basket is a honeycomb structure contained in the MPC, which is designed to locate the stored spent nuclear fuel (SNF). The MPC-32 can house up to 32 intact PWR fuel assemblies. Damaged fuel and fuel debris may be loaded in the MPC-24EF in specially designed damaged fuel containers (DFC). The CoC [11,19] summarizes the type and number of damaged fuel assemblies and fuel debris that may be stored in the MPC. Since the DFC has screens on the top and bottom, the DFC provides no pressure retention function. The confinement function of the DFC is limited to minimizing the release of loose particulates within the sealed MPC. The storage design leakage rates are not altered by the presence of the DFCs. As shown in Chapter 7 of the HI-STORM FSAR [2] the estimated dose to an individual at the site boundary as a result of an effluent release from the MPC-24EF is bounded by the MPC-32.

Upon loading, the MPC is filled with inert helium gas as protection against corrosion and as a leak detection substance. The helium leak rate testing performed on the MPC confinement boundary requires the helium leak rate to be less than or equal to 5×10^{-6} atm-cm^3/s [11,19]. As demonstrated by analysis in the FSAR [2,19], the MPC confinement boundary is not compromised as a result of all normal, off-normal, and accident conditions. Based on the robust nature of the MPC confinement boundary, the non-destructive examination (NDE) of the welds, and the measurement of the helium leakage rate, there is essentially no leakage.

The overpack is a ventilated cylindrical metal and concrete structure which houses the MPC with its contained SNF for storage. The HI-STORM overpack has penetrations at its lower and upper extremities to allow cooling air to flow over the sealed MPC. No credit is taken for the overpack's ability to maintain confinement, as the MPC provides the confinement boundary during storage.

The only means of pressure increase in the MPC is from the temperature rise due to normal heat-up to normal operating temperatures and the release of backfill and fission gas contents from fuel rods into the MPC cavity. Under the most adverse conditions of normal ambient temperature, full insolation, and design basis decay heat, the calculated pressure increase is well below the system design pressure as shown in Chapter 4 of the FSAR [2,19]. For normal conditions of storage, failure of up to 1% of the fuel rods has been analyzed. For off-normal conditions of storage, failure of up to 10% of the fuel rods has been analyzed and would result in an MPC internal pressure below the value specified as the normal design pressure. For accident conditions, with an assumed failure of 100% of the fuel rods, the MPC internal pressure is below the accident condition design pressure.

2.0 Methodology

The potential dose that an individual could receive at or beyond the controlled area boundary[1] from a radioactive material release from the confinement boundary was determined using the methodology described in NUREG-1536 [4], ISG-11 [18] and ISG-5 [16]. To calculate the dose, the following parameters are necessary: the quantity of nuclides available for release, percentage of nuclides that remain airborne, the maximum pressure of the cask cavity, the maximum temperature of the cask cavity, the confinement boundary leakage rate, the distance from the cask to the controlled area boundary, the atmospheric dispersion factor, an individual's breathing rate, an individual's occupancy time, and dose conversion factors.

The MPC uses redundant confinement closures to assure that there is no release of radioactive materials, including fission gases or crud, for all postulated storage accident conditions. The analysis presented in Chapters 3 and 11 of reference [2,19] demonstrates that the MPC remains intact during all normal, off-normal and postulated accident conditions, including the associated increased internal pressure and temperature. The MPC is designed, fabricated and tested in accordance with the applicable requirements of ASME, Section III, Subsection NB [9] to the maximum extent practicable. In summary, there is no design basis event that results in a breach of the MPC confinement boundary.

The above discussion notwithstanding, this document evaluates the consequences of a non-mechanistic postulated ground level breach of the MPC confinement boundary under normal, off-normal and hypothetical accident conditions of storage. This breach could result in the release of gaseous fission products, fines, volatiles and airborne crud particulates. The following doses to an individual were calculated for a minimum controlled area boundary of approximately 1400 feet as a

[1]The terms "controlled area boundary" and "site boundary" are used synonymously throughout this document.

result of an assumed effluent release under hypothetical accident conditions of storage; the committed dose equivalent (CDE) from inhalation and the deep dose equivalent (DDE) from submersion for critical organs and tissues (gonad, breast, lung, red marrow, bone surface, thyroid); the committed effective dose equivalent (CEDE) from inhalation and the deep dose equivalent (DDE) from submersion for the whole body; the lens dose equivalent (LDE) for the lens of the eye; the shallow dose equivalent (SDE) from submersion for the skin; and the resulting Total Effective Dose Equivalent (TEDE) and Total Organ Dose Equivalent (TODE).

The annual dose equivalent for the whole body, thyroid and other critical organs were determined at the minimum controlled area boundary (1400 feet) as a result of an effluent release under normal and off-normal conditions of storage.

For normal and off-normal conditions of storage, the doses were based on the entire ISFSI filled with MPC-32's loaded with design basis fuel. The doses are compared to the regulatory limit for the whole body or any organ, per 10CFR72.104(a) [1]. For hypothetical accident conditions of storage the doses were determined for one MPC-32 and compared to 10CFR72.106(b) [1]. The following sections discuss the methodology utilized to determine the potential dose that an individual could receive due to a non-mechanistic breach of the MPC confinement boundary.

2.1 Confinement Requirements for Normal, Off-Normal and Hypothetical Accident Conditions

2.1.1 Confinement Vessel Releasable Source Term

In accordance with ISG-5 [16] and NUREG/CR-6487 [6], the following contributions are considered in determining the releasable source term: (1) the radionuclides comprising the fuel rods, (2) the radionuclides on the surface of the fuel rods, and (3) the residual contamination on the inside surfaces of the vessel. In accordance with NUREG/CR-6487, contamination due to residual activity on the cask interior surfaces is negligible as compared to crud deposits on the fuel rods themselves and therefore may be neglected. The source terms considered for this calculation are from the spallation of crud from the fuel rods, and from the fines, gases and volatiles, which result from cladding breaches. The methodology of NUREG/CR-6487 is conservatively applied to the storage confinement analysis, as dry storage conditions are less severe than transport conditions.

The inventory for isotopes other than ^{60}Co is calculated with the SAS2H and ORIGEN-S modules of the SCALE 4.3 system as described in *HI-STAR 100 Shielding Design and Analysis for Transport and Storage* [5]. The inventory for the MPC-32 was based on the B&W 15x15 fuel assembly with a burnup of 55,000 MWD/MTU, 5 years cooling time, and an enrichment of 4.0%. This assumed burnup and cooling time is chosen to conservatively bound the actual burnup and cooling times for all fuel at the Diablo Canyon site. Documentation that the design basis fuel assembly bounds the fuel at the Diablo Canyon site is provided in Appendix C. All isotopes that contribute greater than 0.1% to the total curie inventory for the fuel assembly are considered in the evaluation as fines. This analysis also includes those actinides that contribute greater than 0.01% to the total curie inventory as the dose conversion factors for these isotopes are in general, greater than other isotopes (e.g., isotopes of plutonium, americium, curium, and neptunium).

For storage of spent fuel assemblies with burnups in excess of 45,000 MWD/MTU, under normal and off-normal conditions, the source term from the assumed rod breakage fractions of ISG-5 [16] must be augmented by the source term from 50% of the rods having peak cladding oxide thicknesses greater than 70 micrometers. ISG-11 [18] recommends that for high burnup fuel assemblies to be classified as intact, no more than 3% of the rods may have peak cladding oxide thicknesses greater than 70 micrometers and no more than 1% of the rods may have peak cladding oxide thicknesses greater than 80 micrometers. Using Equation 2-1 below, the fraction of the source term available for release may be determined:

Equation 2-1

$$F_R = F_B * (100\%) + F_{70} * P_S$$

where:

F_R is the percentage of the source term available for release,
F_B is the rod breakage fraction from ISG-5 [16],
F_{70} is the fraction of rods that have peak cladding oxide thicknesses greater than 70 microns, and
P_S is the percentage of the source term for rods having peak cladding thicknesses greater than 70 microns that must be included in the total source term available for release.

Table 2-1 contains a summary of the values required for Equation 2-1 and the results for normal and off-normal conditions of storage. It is assumed that 100% of the source term is available for release under hypothetical accident conditions of storage.

2.1.2 Crud Radionuclides

The majority of the activity associated with crud is due to ^{60}Co [6]. The inventory for ^{60}Co was determined by using the crud surface activity for PWR rods (140×10^{-6} Ci/cm^2) provided in NUREG/CR-6487 [6] multiplied by the surface area per assembly (3×10^5 cm^2 for PWR, also provided in NUREG/CR-6487). The source terms were then decay corrected 5 years using the basic radioactive decay equation:

Equation 2-2

$$A(t) = A_0 e^{-\lambda t}$$

where:

$A(t)$ is activity at time t [Ci],
A_0 is the initial activity [Ci],
λ is the $\ln 2/t_{1/2}$ (where $t_{1/2}$ = 5.272 years for ^{60}Co [14]), and
t is the time in years (5 years).

2.1.3 Release of Contents under Normal, Off-Normal and Non-Mechanistic Accident Conditions of Storage

2.1.3.1 Confinement Boundary Leakage Rate

The helium leak rate testing performed on the MPC confinement boundary measures the helium leak rate under reference test conditions to be less than or equal to 5×10^{-6} atm-cm^3/s as required by the CoC [11,19]. As demonstrated by analysis, the MPC confinement boundary is not compromised as a result of normal, off-normal, and accident conditions. Based on the robust nature of the MPC confinement boundary, the NDE inspection of the welds, and the measurement of the helium leakage rate, there is essentially no leakage. However, it is conservatively assumed that the maximum possible leakage rate is 5.0×10^{-6} atm-cm^3/s, under reference test conditions.

Equation B-1 of ANSI N14.5-1997 [8] is used to express this mass-like helium flow rate (Q_u) measured in atm-cm^3/s as a function of the upstream volumetric leakage rate (L_u) as follows:

Equation 2-3

$$Q_u = L_u * P_u \quad \text{atm-cm}^3\text{/s (Equation B-1 from ANSI N14.5-1997)}$$

$$L_u = Q_u / P_u \ \text{cm}^3\text{/s}$$

where:

L_u is the upstream volumetric leakage rate [cm^3/s]
Q_u is the mass-like helium leak rate [atm-cm^3/s], and
P_u is the upstream pressure [ATM]

The corresponding leakage rate at normal, off-normal and hypothetical accident conditions is determined using the following methodology. For conservatism, unchoked flow correlations were used as the unchoked flow correlations better approximate the true measured flowrate for the leakage rates associated with storage packages. Using the equations for molecular and continuum flow (Equation B-5) provided in ANSI N14.5-1997 [8], the corresponding capillary diameter, D, was calculated under the reference test conditions of Table 7-2. Reference test conditions are used to calculate the capillary diameter as they yield more conservative results than the actual test conditions in Table 7-2. The capillary length required for Equation 2-4 was conservatively chosen to be the MPC lid closure weld, which is 1.9 cm.

Equation 2-4

$$L_u = [\frac{2.49x10^6\, D^4}{a\, u} + \frac{3.81x10^3\, D^3 \sqrt{\frac{T}{M}}}{a\, P_a}][P_u - P_d][\frac{P_a}{P_u}]$$

where:

L_u	is the allowable leakage rate at the upstream pressure [cm^3/s],
a	is the capillary length [cm],
T	is the temperature [°K],
M	is the gas molecular weight [g/mole] from ANSI N14.5, Table B1 [8],
u	is the fluid viscosity for helium [cP] from Rosenhow and Hartnett [10]
P_u	is the upstream pressure [ATM],
P_d	is the downstream pressure [ATM],
P_a	is the average pressure; $P_a = (P_u + P_d)/2$ [ATM], and
D	is the capillary diameter [cm].

Using the capillary diameter determined above, and the parameters for normal, off-normal and hypothetical accident conditions provided in Table 7-2, Equation 2-4 was solved for the leakage rate at the upstream conditions for each condition of storage. The parameters provided in Table 7-2 are for the HI-STORM cask system and result in a bounding leakage rate for both the HI-STORM and HI-STAR cask systems.

2.1.3.2 Percentage of Nuclides that Remain Airborne

In addition to the small fraction of fines that are released in the event of a cladding breach only about 10 % of the fines released to the MPC cavity remain airborne long enough to be available for release from the cask MPC [15]. It is conservatively assumed that 100% of the volatiles, crud and gases remain airborne and available for release.

2.1.3.3 Fraction of Volume Released

Dividing the upstream leakage rate by the minimum free volume of the confinement vessel provides the fraction of volume released per second. The minimum free volume of the confinement vessel is presented in the spreadsheets contained in Appendix A of this document.

2.1.3.4 Release Fraction

The release fraction is that portion of the total radionuclide inventory that is available for release from the spent nuclear fuel. These fractions account for the radionuclides trapped in the fuel matrix and radionuclides that exist in a chemical or physical form that is not releasable to the environment under credible normal, off-normal and hypothetical accident conditions. The release fractions provided in ISG-5 [16] were used and are additionally provided in Table 7-1.

2.1.3.5 Radionuclide Release Rate

The radionuclide release rate is the product of the quantity of isotopes available for release, the number of assemblies, the percentage that remains airborne, the fraction of volume released, and the release fraction.

2.1.3.6 Atmospheric Dispersion Factor

For the evaluation of the annual dose due to an effluent release for normal and off-normal conditions of storage at the controlled area boundary, the long-term site-specific χ/Q atmospheric dispersion factor was provided by Pacific Gas & Electric in a letter from Richard Klimczak to Eric Lewis [20,22,23]. Reference [20] presents the annual average χ/Q value for nine of the sixteen cardinal directions. The other seven cardinal directions are considered to be unoccupied as they are over water [21]. For conservatism the maximum annual average χ/Q value of 3.44×10^{-6} s/m^3, which occurs in the NW direction, was chosen.

The short-term atmospheric dispersion factor for accident conditions at the minimum controlled area boundary of 1400 feet was also provided by Pacific Gas & Electric [3]. The atmospheric dispersion factor of 4.5×10^{-4} s/m^3 provided for the hypothetical accident conditions assumes a release duration of one hour. Although the release period for hypothetical accident conditions is assumed to be 30 days, the χ/Q value for the one-hour release period is selected as it conservatively bounds the actual atmospheric dispersion factor under accident conditions.

The two χ/Q values above, provided by Pacific Gas and Electric, are conservative values and applicable at both 1325 and 1400 feet. The use of the χ/Q values is conservative and insures that the doses presented in Table 9-2 are conservative.

All correspondence with Pacific Gas & Electric concerning χ/Q values for normal, off-normal and hypothetical accident conditions of storage are included in Appendix B for reference.

2.1.3.7 Dose Conversion Factors

Dose Conversion Factors (DCF) from EPA Federal Guidance Report No. 11, Table 2.1 [12] and EPA Federal Guidance Report No. 12, Table III.1 [13] were used for the analysis.

2.1.3.8 Occupancy Time

An occupancy time of 8,760 hours is used for the analysis for normal and off-normal conditions of storage [4]. This conservatively assumes that the individual is exposed 24 hours per day for 365 days at the controlled area boundary distance of 1400 feet.

An occupancy time of 720 hours is used for the analysis for hypothetical accident conditions. This conservatively assumes that the individual is exposed 24 hours per day for 30 days at the minimum controlled area boundary distance of 1400 feet. The accident event duration is considered conservative as any accident condition of storage resulting in the failure of 100% of the stored fuel rods would be detected by the routine security and surveillance inspections and corrective actions would be completed prior to the end of this 30 day period.

2.1.3.9 Breathing Rate

A breathing rate of 3.3×10^{-4} m^3/sec for a worker was used for the analysis [16]. This conservatively bounds the adult breathing rate (BR) of 2.5×10^{-4} m^3/sec for an individual.

2.1.4 Postulated Doses

Postulated doses are calculated for inhalation and external submersion in the plume at the controlled area boundary. For normal, off-normal and hypothetical accident conditions the dose is calculated at the minimum controlled area boundary distance of 1400 feet. The postulated doses as a result of exposure to soil with ground surface contamination and soil contaminated to a depth of 15 cm were also determined in the HI-STORM FSAR [2,19] and determined to be negligible compared to submersion in the plume and are therefore not reported.

2.1.4.1 Normal/Off-normal conditions

The annual dose equivalent for the whole body, thyroid and other critical organs were determined at the minimum controlled area boundary (1400 feet) as a result of an effluent release under normal and off-normal conditions of storage. These doses were based on each HI-STORM cask containing an MPC-32 loaded with design basis fuel.

2.1.4.2 Accident Conditions

The following doses to an individual at the minimum controlled area boundary of 1400 feet as a result of an assumed effluent release from a single cask under hypothetical accident conditions of storage were determined; the committed dose equivalent (CDE) from inhalation and the deep dose equivalent (DDE) from submersion for critical organs and tissues (gonad, breast, lung, red marrow, bone surface, thyroid); the committed effective dose equivalent (CEDE) from inhalation and the deep dose equivalent (DDE) from submersion for the whole body; the lens dose equivalent (LDE) for the lens of the eye; the shallow dose equivalent (SDE) from submersion for the skin; and the resulting Total Effective Dose Equivalent (TEDE) and Total Organ Dose Equivalent(TODE).

2.1.4.3 Whole Body Dose

The Total Effective Dose Equivalent (TEDE) to the whole body is the sum of the committed effective dose equivalent (CEDE) and the deep dose equivalent (DDE) for the whole body.

The CEDE is the product of the radionuclide release rate, the atmospheric dispersion factor, the occupancy time, the breathing rate, and the dose conversion factor.

The DDE is the product of the nuclide release rate, the atmospheric dispersion factor, the occupancy time, and the dose conversion factor.

The Annual Dose Equivalent (ADE) for the whole body is the sum of the CEDE and the DDE for the whole body.

2.1.4.4 Critical Organ Dose

The Total Organ Dose Equivalent to the critical organ (or tissue) is the sum of the committed dose equivalent (CDE) to the critical organ or tissue from inhalation and the deep dose equivalent (DDE) to the organ or tissue from submersion in the plume.

The ADE to any critical organ (including thyroid) is the sum of the CDE and the DDE for that critical organ.

The CDE to the organ or tissue from inhalation is the product of radionuclide release rate, the atmospheric dispersion factor, the occupancy time, the breathing rate, and the organ/tissue dose conversion factor. The shallow dose equivalent and the deep dose equivalent to the organ or tissue from submersion in the plume is the product of the nuclide release rate, the atmospheric dispersion factor, the occupancy time, and the organ/tissue dose conversion factor.

The lens dose equivalent (LDE) as a result of submersion in the plume was estimated using guidance from Dr. James Turner in his book, *Atoms, Radiation, and Radiation Protection* [17]. Dr. Turner states that alpha particles and low-energy beta particles, such as those from tritium, cannot penetrate to the lens of the eye (at a depth of 3 mm). The discussion continues that many noble gases emit photons and energetic beta particles, which in turn must be considered in the dose estimate. Dr. Turner states that the dose-equivalent rate to tissues near the surface of the body (e.g., lens of the eye) is more than 130 times the dose-equivalent rate in the lung from gases contained in the lung. Using the accident condition of storage for the MPC-32 (which is the highest dose to the lung), the estimated dose to the lung from gases in the lung is 1.45×10^{-4} mrem. Conservatively multiplying this value by 150, the estimated LDE is 2.175×10^{-2} mrem. This estimated LDE is a small fraction of the 15 rem limit imposed by 10CFR72.106(b).

3.0 Acceptance Criteria

The ISFSI must be demonstrated to meet the confinement accident condition requirements of 10CFR72.106 [1] for storage of spent nuclear fuel. 10CFR72.106(b) [1] specifies that any individual located on or beyond the nearest boundary of the controlled area may not receive from any design basis accident the more limiting of a total effective dose equivalent of 5 rem to the whole body, or a total organ dose equivalent to any individual organ or tissue (other than the lens of the eye) of 50 rem. The lens dose equivalent shall not exceed 15 rem and the shallow dose equivalent shall not exceed 50 rem.

Additionally, the ISFSI must meet the normal and anticipated occurrences (off-normal) requirements of 10CFR72.104 [1]. 10CFR72.104(a) specifies that the annual dose equivalent to any individual at or beyond the controlled area boundary must not exceed 25 mrem to the whole body, 75 mrem to the thyroid and 25 mrem to any other critical organ.

This calculation package provides the effluent dose portion in support of the requirement that the licensee perform a site-specific dose evaluation as part of the ISFSI design as dictated in 10CFR72.212 [1] and Chapter 12 [2,19] to demonstrate compliance with 10CFR72.104 [1]. Direct doses must be added to these effluent doses to determine compliance with these regulations.

4.0 Assumptions

The following are a summary of assumptions for the confinement analysis of the cask system.

- The minimum distance from the cask to the controlled area boundary is 1400 feet [23]. The controlled area boundary is at least 100 meters from the nearest loaded HI-STORM 100 System in accordance with the requirement of 10CFR72.106(b) [1].

- The short-term χ/Q value for normal and off-normal conditions provided, is a conservative value and applicable at 1400 feet. The maximum χ/Q value for a one hour release period was chosen to determine a bounding χ/Q value for the ISFSI, which is located approximately 1400 feet from the plant boundary. Additionally, the selection of the maximum χ/Q value based on a one hour release period ensures that the χ/Q value used to calculate the dose due to an effluent release under accident conditions is conservative for the accident duration of 30 days.

- The long-term χ/Q value for normal and off-normal conditions is provided for a distance of 1325 feet in nine of the sixteen cardinal directions. This χ/Q value provided at 1325 feet is conservative and also applicable for the actual distance to the controlled area boundary of 1400 feet. At a distance of 1400 feet from the ISFSI the other seven cardinal directions are over water and are considered to be unoccupied. The maximum annual average χ/Q value from the 16 cardinal directions is chosen to determine a bounding χ/Q value for the ISFSI. This ensures that the χ/Q value used to calculate the dose due to an effluent release under normal and off-normal conditions is conservative.

- Under normal conditions of storage, 2.5% of the source term is available for release. Under off-normal conditions of storage 11.5% of the source term is available for release. Under accident conditions 100% of the source term is available for release. These fractions are in accordance with ISG-5 [16], ISG-11 [18] and NUREG-1536 [4].

- Unchoked flow correlations were used as the unchoked flow correlations better approximate the true measured flow rate for the leakage rates associated with transportation packages.

- For conservatism, the upstream pressure at reference test conditions (inside of the MPC) is assumed to be 2 ATM and the down stream pressure (outside of the MPC) is assumed to be 1 ATM.

- The leak hole diameter is determined using reference test conditions rather than actual test conditions from Table 7-2. This is conservative as it yields a larger leak hole diameter.

- It is assumed that only 10% of the fines remain in an aerosol form long enough to be available for release from the confinement boundary. It is conservatively assumed that 100% of the volatiles, gases and crud remain in an aerosol form.

- The temperature at test conditions is assumed to be equal to an ambient reference temperature, 212° F based on the maximum temperature achievable by the water in the MPC during performance of the leak test. This is conservative because the leak hole diameter computed from these test conditions is larger.

- Temperatures and pressures in Table 7-2 are bounding values for normal/off-normal and accident conditions of storage.

- The capillary length required for Equation 2-3 was chosen to be the MPC lid closure weld size which is 1.9 cm.

- The majority of the activity associated with crud is due to ^{60}Co. This assumption follows from the discussion provided in NUREG/CR-6487 [6].

- The assumption is made that the maximum possible leakage rate is equal to 5.0×10^{-6} atm-cm^3/sec under reference test conditions. This leakage rate is conservative because based on the robust nature of the MPC confinement boundary, the non-destructive examination (NDE) of the welds, and the measurement of the helium leakage rate; there is essentially no leakage. This is consistent with the helium leak rate test which requires that the leakage rate to be less than 5.0×10^{-6} atm-cm^3/sec.

- The leakage rate persists for the entire duration of the given evaluated condition of storage (1 year for normal/off-normal and 30 days for accident conditions) without a decrease in the nuclide concentration due to radioactive decay. The accident event duration is considered conservative as any accident condition of storage resulting in the failure of 100% of the stored fuel rods would be detected and corrective actions would be completed prior to the end of this 30 day period.

- The individual at the site boundary under normal and off-normal conditions of storage is exposed for 8,760 hours. This conservatively assumes that the individual is exposed 24 hours per day for 365 days. The individual at the site boundary under accident conditions of storage is exposed for 720 hours. This conservatively assumes that the individual is exposed 24 hours per day for the entire 30 days.

- It is conservatively assumed that all fuel stored in the MPC is of the design basis type with a bounding burnup and cooling time.

- Dose conversion factors chosen for inhalation reported in EPA Federal Guidance Report No. 11, Table 2.1 [12] were selected by lung clearance class, which reports the most conservative values.

- Internal temperature and pressure of the MPC for calculation of the confinement boundary leakage rate under normal and off-normal conditions of storage are taken from the HI-STORM FSAR [2,19]. These values result in a leakage rate that bounds the leakage rate for the temperatures and pressures in the HI-STAR TSAR [7].

5.0 Input Data

Information on the configuration of the HI-STORM System and the acceptable contents are provided in reference [11,19]. Specific input data and its corresponding reference are provided in Section 7.0. All input data is presented on the spreadsheets in Appendix A.

6.0 Computer Codes

Microsoft Excel and Mathcad are the only computer codes used for this analysis.

7.0 Analysis

7.1 Confinement Vessel Releasable Source Term

The isotope inventory for isotopes other than ^{60}Co was found in *HI-STAR 100 Shielding Design and Analysis for Transport and Storage* [5]. A summary of the isotope inventories is provided in Table 7-1.

7.2 Crud Radionuclides

The inventory for ^{60}Co was determined using the methodology described in Section 2.1.2 with the following results:

Total ^{60}Co crud is 140 $\mu Ci/cm^2$ for PWR (NUREG/CR-6487 [6]).

PWR

Surface area per assy = 3.0E+05 cm^2

140 $\mu Ci/cm^2$ x 3.0E+05 cm^2 = 42.0 Ci

$^{60}Co(t) = {}^{60}Co_0\, e^{-(\lambda t)}$, where $\lambda = \ln 2/t_{1/2}$, t = 5 years (MPC-32), $t_{1/2}$ = 5.272 years for ^{60}Co [14].

MPC-32

$$^{60}Co(5) = 42.0 \text{ Ci } e^{-(\ln 2/5.272)(5)}$$

$$^{60}Co(5) = 21.77 \text{ Ci}$$

7.3 Confinement Boundary Leakage Rate

7.3.1 Actual versus Reference Test Conditions

Table 7-2 presents a summary of the parameters used in Equation 2-4 for the hypothetical reference test conditions and the actual test conditions for which the helium leak rate test is performed. The MPC helium leak rate test is performed at an elevated pressure (85 psig minimum) to magnify the leakage rate. Meanwhile the Operating Procedures of the HI-STORM FSAR [2,19] requires that the helium leakage rate be less than 5.0×10^{-6} atm-cm^3/sec based on a 1 ATM pressure differential across the weld joint. Therefore, the use of reference test conditions to determine the capillary diameter is acceptable, as the leakage rate under actual test conditions is correlated to reference test conditions.

7.3.2 Calculation of the Leakage Rate

The methodology described in Section 2.1.3.1 was used to determine the leakage rate for normal, off-normal, and hypothetical accident conditions. Using the equations for molecular and continuum flow, Equation B-5 provided in ANSI N14.5-1997 [8], the corresponding capillary diameter, D, was calculated. For conservatism, the upstream pressure at reference test conditions (inside of the MPC) is assumed to be 2 ATM (minimum) and the down stream pressure (outside of the MPC) is assumed to be 1 ATM (at 298 K), therefore, the average pressure is 1.5 ATM. The evaluation was performed using the helium gas temperature at reference test conditions of both 70°F and 212°F. These temperatures are representative of the possible temperature of the helium gas in the confinement vessel during the helium leak test. The 212°F helium temperature is the upper bound because the water inside the MPC is shown not to boil in Chapter 4 as long as the "time-to-boil" time limit is not exceeded. From the two calculations using the two temperatures, it was determined that the higher temperature (212°F) results in a greater capillary diameter. The capillary length required for Equation 2-3 was conservatively chosen to be the MPC lid closure weld, which is 1.9 cm. Table 7-2 provides a summary of the parameters used in the calculation. The capillary diameter (D) computed from the above equation is equal to 4.44×10^{-4} cm. Using this capillary diameter and the parameters for normal and off-normal conditions provided in Table 7-2, Equation 2-4 was solved for the normal/off-normal leakage rate at the upstream conditions. The resultant normal and off-normal condition leakage rate, 7.37×10^{-6} cm^3/s (at 581 K, 6.90 ATM) was calculated. Using the capillary diameter determined above, and the parameters for accident conditions provided in Table 7-2, Equation 2-4 was solved for the hypothetical accident leakage rate at the upstream conditions. The resultant hypothetical accident leakage rate, 1.28×10^{-5} cm^3/s (at 843 K, 16.31 ATM) was calculated.

7.4 Fraction of Volume Released

Dividing the upstream leakage rate determined above by the minimum free volume of the confinement vessel provided in Chapter 4 of reference [2,19] the fraction of volume released was determined. The fraction of volume released (as well as the minimum free volumes) is presented in the Excel spreadsheets in Appendix A for each condition of storage.

7.5 Atmospheric Dispersion Factor

For the evaluation of the annual dose rate at the controlled area boundary under normal, off-normal and hypothetical accident conditions of storage the long-term χ/Q (3.44×10^{-6} sec/m^3) and short-term χ/Q (4.5×10^{-4} sec/m^3) were supplied by Pacific Gas & Electric [3,20].

7.6 Whole Body and Critical Organ Dose

The following doses to an individual at the controlled area boundary (1400 feet) as a result of an assumed effluent release under normal, off-normal and accident conditions of storage were determined; the committed dose equivalent (CDE) from inhalation and the deep dose equivalent (DDE) from submersion for critical organs and tissues (gonad, breast, lung, red marrow, bone surface, thyroid; the committed effective dose equivalent (CEDE) from inhalation and the deep dose equivalent (DDE) from submersion for the whole body; the lens dose equivalent (LDE) for the lens of the eye; the skin dose equivalent (SDE) from submersion for the skin; and the resulting Total Effective Dose Equivalent (TEDE) and Total Organ Dose Equivalent (TODE). The annual dose equivalent for the whole body, thyroid and other critical organs were determined at the minimum controlled area boundary (1400 feet) as a result of an effluent release under normal and off-normal conditions of storage. The doses for normal and off-normal conditions were based on each HI-STORM cask containing an MPC-32 loaded with design basis fuel; the doses for hypothetical accident conditions were determined for a single MPC-32 loaded with design basis fuel. The doses were calculated using Excel spread sheets, which are provided in Appendix A, and summarized in Table 9-1.

8.0 Computer Files

All Microsoft Excel spreadsheets and documents to support this analysis are located on the Holtec International server at f:\projects\1073\kc\2002513

9.0 Results

The doses to an individual at the minimum controlled area boundary distance of 1400 feet from a single cask are presented in Table 9-1 for normal, off-normal and hypothetical accident conditions. Table 9-2 presents the doses due to an effluent release at the minimum controlled area boundary of 1400 feet from the Diablo Canyon ISFSI and compares them to the regulatory limits of 10CFR72.104(a) for normal and off-normal conditions and 10CFR72.106(b) for accident conditions. The doses for normal and off-normal conditions in Table 9-2 are based on the ISFSI holding 140 casks, while the doses for accident conditions are presented for a single cask.

10.0 Conclusion

As can be seen from Table 9-2, the estimated doses as a consequence of a non-mechanistic postulated ground level breach of the MPC confinement boundary under normal, off-normal, and hypothetical accident conditions of storage are a fraction of the regulatory limit specified in 10CFR72.104(a) and 10CFR72.106(b).

This calculation of dose due to effluent release satisfies in part the requirement of 10CFR72.212 for the licensee to perform a site-specific dose evaluation as part of the ISFSI design to demonstrate compliance with 10CFR72.104. The doses in this report must be added to the direct dose results.

11.0 References[2]

[1] 10CFR72, Licensing Requirements for the Independent Storage of Spent Nuclear Fuel and High-Level Radioactive Waste.

[2] HI-STORM 100 System FSAR, Holtec Report HI-941184 (Revision 0), USNRC Docket Number 72-1014.

[3] Specification 10012-N-NPG, Section 6.2.10, pgs 46-47 (Appendix B)

[4] NUREG-1536, "Standard Review Plan for Dry Cask Storage Systems", January, 1997.

[5] Redmond II, E.L., *HI-STAR 100 Shielding Design and Analysis for Transport and Storage*, HI-951322, most current revision.

[6] Anderson, B.L. et al. *Containment Analysis for Type B Packages Used to Transport Various Contents.* NUREG/CR-6487, UCRL-ID-124822. Lawrence Livermore National Laboratory, November 1996.

[7] HI-STAR 100 System TSAR, Holtec Report HI-941184 (Proposed Revision 11), USNRC Docket Number 72-1008.

[8] ANSI N14.5-1997. "American National Standard for Radioactive Material Leakage Tests on Packages for Shipment."

[9] American Society of Mechanical Engineers (ASME), Boiler and Pressure Vessel Code, Section III, Division 1, Subsection NB, Class 1 Components, 1995 Edition.

[10] Rosenhow, W.M. and Hartnett, J.P., *Handbook of Heat Transfer*, McGraw Hill Book Company, New York, 1973.

[11] HI-STORM 100 Part 72 Certificate of Compliance 1014, Rev 0.

[12] U.S. EPA, Federal Guidance Report No. 11, *Limiting Values of Radionuclide Intake and Air Concentration and Dose Conversion Factors for Inhalation, Submersion, and Ingestion*, DE89-011065, 1988.

[2]This revision status of Holtec documents cited above is subject to updates as the project progresses. This document will be revised if a revision to any of the above-referenced Holtec work products materially affects the instructions, results, conclusions or analyses contained in this document. Otherwise, a revision to this document will not be made and the latest revision of the referenced Holtec documents shall be assumed to supercede the revision number cited above. The Holtec Project Manager bears the undivided responsibility to insure that there is no intra-document conflict with respect to the information contained in all Holtec generated documents on a safety significant project.

[13] U.S. EPA, Federal Guidance Report No. 12, *External Exposure to Radionuclides in Air, Water, and Soil*, EPA 402-R-93-081, 1993.

[14] Shleien, B, *The Health Physics and Radiological Health Handbook*, Scinta, Inc. Silver Spring, MD, 1992.

[15] Rashid, Y.R., et al, "An Estimate of the Contribution of Spent Fuel Products to the Releasable source Term in Spent Fuel Transport Casks," SAND88-2778C, Sandia National Laboratories, 1988

[16] Interim Staff Guidance-5, Revision 1, "Normal, Off-Normal and Hypothetical Dose Estimate Calculations", June 18, 1999

[17] Turner, James E., *Atoms, Radiation and Radiation Protection* ", McGraw Hill Book Company, New York, 1992.

[18] Interim Staff Guidance-11, Revision 1, "Transportation and Storage of Spent Fuel Having Burnups in Excess of 45GWD/MTU", May 16, 2000

[19] Holtec International License Amendment Request 1014-1, Supplement 1, October 2000.

[20] Letter to Eric Lewis from Richard Klimczak, "Diablo Canyon ISFSI Project", September 28, 2000. (Appendix B)

[21] Letter to Eric Lewis from Richard Klimczak, "Diablo Canyon ISFSI Project", October 11, 2000. (Appendix B)

[22] Letter to Eric Lewis from Richard Klimczak, "Diablo Canyon ISFSI Project", October 19, 2000 (Appendix B)

[23] Email to Eric Lewis from Richard Klimczak, "FW: Questions on New ISFSI Layout", January 8, 2001 (Appendix B)

Table 2-1
Parameters for Determining the Percentage of the Source Term Available for Release

MPC-24, MPC-24E, MPC-24EF, MPC-32, MPC-68 and MPC-68FF

Parameter	Normal	Off-Normal
F_B	.01	.10
F_{70}	.03	.03
P_S	50%	50%
F_R	**2.5%**	**11.5%**

Table 7-1
Isotope Inventory and Release Fraction
Ci/Assembly

Nuclide	MPC-32 Ci/Assembly	Release Fraction
Gases		
^{3}H	2.97E+02	0.30
^{129}I	2.64E-02	0.30
^{85}Kr	4.82E+03	0.30
Crud		
^{60}Co	2.18E+01	0.15 normal /off-normal 1.0 accident
Volatiles		
^{90}Sr	5.10E+04	2.0E-04
^{106}Ru	1.44E+04	2.0E-04
^{134}Cs	3.01E+04	2.0E-04
^{137}Cs	7.82E+04	2.0E-04
Fines		
^{241}Pu	7.75E+04	3.0 E-05
^{90}Y	5.10E+04	3.0 E-05
^{147}Pm	2.57E+04	3.0 E-05
^{154}Eu	4.51E+03	3.0 E-05
^{244}Cm	5.57E+03	3.0 E-05
^{238}Pu	3.76E+03	3.0 E-05
^{125}Sb	1.99E+03	3.0 E-05
^{155}Eu	1.28E+03	3.0 E-05
^{241}Am	8.06E+02	3.0 E-05

Table 7-1
(continued)
Isotope Inventory and Release Fractions

Nuclide	MPC-32 Ci/Assembly	Release Fraction
^{240}Pu	3.65E+02	3.0 E-05
^{239}Pu	1.99E+02	3.0 E-05
^{137m}Ba	7.38E+04	3.0 E-05
^{106}Rh	1.44E+04	3.0 E-05
^{144}Ce	8.14E+03	3.0 E-05
^{144}Pr	8.14E+03	3.0 E-05
^{125m}Te	4.86E+02	3.0 E-05

Note: The isotopes which contribute greater than 0.1% to the total curie inventory for the fuel assembly are considered in the evaluation as fines. The analysis also includes actinides which contribute greater than 0.01% to the total curie inventory for the fuel assembly. This is in accordance with ISG-5 [16].

Table 7-2
Parameters for Test and Hypothetical Accident Conditions

Parameter	Actual Test	Reference Test	Normal/Off-Normal	Hypothetical Accident
P_u	6.78 ATM (min)	2 ATM (min)	6.90 ATM	16.31 ATM
P_d	1 ATM	1 ATM	1 ATM	1 ATM
T	373 K	373 K	581 K	843 K
M	4 g/mol	4 g/mol	4 g/mol	4 g/mol
u (helium)	0.0231 cP	0.0231 cP	0.0309 cP	0.0397 cP
a	1.9 cm	1.9 cm	1.9 cm	1.9 cm

Table 9-1

MPC-32
Postulated Doses
To An Individual at the Controlled Area Boundary (1400 feet)
As a Result of an Assumed Effluent Release (1 cask)

Normal Conditions [mrem/yr]

	Gonad	Breast	Lung	Red Marrow	Bone Surface	Thyroid
CDE	2.24E-04	3.35E-04	1.04E-02	1.35E-03	8.69E-03	3.01E-04
DDE	6.38E-06	7.21E-06	6.42E-06	6.37E-06	9.29E-06	6.58E-06
ADE	2.30E-04	3.42E-04	1.04E-02	1.36E-03	8.70E-03	3.08E-04

	Skin/Extremity
SDE	1.48E-05

	Whole Body
CEDE	1.92E-03
DDE	6.53E-06
ADE	1.93E-03

Off-Normal Conditions [mrem/yr]

	Gonad	Breast	Lung	Red Marrow	Bone Surface	Thyroid
CDE	7.49E-04	4.51E-04	2.74E-02	5.18E-03	3.92E-02	4.24E-04
DDE	7.23E-06	8.18E-06	7.27E-06	7.19E-06	1.07E-05	7.45E-06
ADE	7.56E-04	4.59E-04	2.74E-02	5.19E-03	3.92E-02	4.31E-04

	Skin/Extremity
SDE	4.22E-05

	Whole Body
CEDE	5.32E-03
DDE	7.40E-06
ADE	5.33E-03

Accident Conditions [mrem/30 days]

	Gonad	Breast	Lung	Red Marrow	Bone Surface	Thyroid
CDE	1.19E-01	6.19E-02	4.24E+00	8.31E-01	6.36E+00	5.88E-02
DDE	1.40E-03	1.59E-03	1.39E-03	1.37E-03	2.13E-03	1.44E-03
ADE	1.20E-01	6.35E-02	4.24E+00	8.32E-01	6.36E+00	6.02E-02

	Skin/Extremity
SDE	2.62E-02

	Whole Body
CEDE	8.27E-01
DDE	1.43E-03
TEDE	8.28E-01

Table 9-2

Postulated Bounding Doses Compared to Regulatory Limits
To An Individual at the Controlled Area Boundary (1400 feet)
As a Result of an Assumed Effluent Release from the Diablo Canyon ISFSI

	Dose Rate	Regulatory Limit
10CFR72.104(a) - Normal (140 Cask ISFSI)		
Whole body ADE	0.27 mrem/yr	25 mrem/yr
Thyroid ADE	0.043 mrem/yr	75 mrem/yr
Critical Organ ADE (Max)	1.46 mrem/yr	25 mrem/yr
10CFR72.104(a) - Off-normal (140 Cask ISFSI)		
Whole body ADE	0.75 mrem/yr	25 mrem/yr
Thyroid ADE	0.060 mrem/yr	75 mrem/yr
Critical Organ ADE (Max)	5.49 mrem/yr	25 mrem/yr
10CFR72.106(b) - Accident (1 cask)		
TEDE	0.83 mrem/30 days	5 rem/30 days
TODE=DDE+CDE (Max)	6.36 mrem/30 days	50 rem/30 days
LDE	0.022 mrem/30 days	15 rem/30 days
SDE	0.026 mrem/30 days	50 rem/30 days

ADE: Annual Dose Equivalent
TEDE: Total Effective Dose Equivalent
TODE: Total Organ Dose Equivalent
DDE: Deep Dose Equivalent
CDE: Committed Dose Equivalent
LDE: Lens Dose Equivalent
SDE: Shallow Dose Equivalent

Appendix A

Dose Evaluation Spread Sheets

(Total of 46 pages including this cover page)

Equations Used in Appendix A Spreadsheets:

Inhalation Spreadsheets:

Fraction Released per Sec = $L_{nor/off/acc}$ Rate at Upstream / MPC Volume

Release Rate=Inventory* % available for release* % remain airborne*No. Assy*Frac Released per sec*Release Frac

DCF (mrem/μCi) = DCF (Sv/Bq)*3.7 x10^9

(CDE/CEDE) = Release Rate * X/Q * Breathing Rate * DCF(mrem/μCi) *Occupancy Time / 1x10^{-6}

Submersion Spreadsheets:

Fraction Released per Sec = $L_{nor/off/acc}$ Rate at Upstream / MPC Volume

Release Rate=Inventory* % available for release* % remain airborne*No. Assy*Frac Released per sec*Release Frac

DCF (mrem/μCi) = DCF (Sv/Bq)*3.7 x10^9

(DDE/SDE) = Release Rate * X/Q * DCF(mrem/μCi) *Occupancy Time / 1x10^{-6}

MPC-32															
Normal Conditions															
Committed Effective Dose Equivalent From Inhalation															
Nuclide	Inventory (Ci/Assy)	% available for release	% remain airborne	No. Assy	MPC Vol (cm3)	L_{nor} Rate at Upstream (cm3/s)	Fraction Released per sec	Release Fraction	Release Rate (Ci/sec)	X/Q (sec/m3)	Breathing Rate (m3/sec)	DCF (Sv/Bq)	DCF (mRem/uCi)	Occ Time (sec)	CDE (mRem)
									Gases						
H 3	2.97E+02	2.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.30	8.49E-11	3.44E-06	3.30E-04	1.73E-11	6.40E-02	3.15E+07	1.94E-07
I129	2.64E-02	2.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.30	7.55E-15	3.44E-06	3.30E-04	8.69E-11	3.22E-01	3.15E+07	8.68E-11
KR 85	4.82E+03	2.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.30	1.38E-09	3.44E-06	3.30E-04	0.00E+00	0.00E+00	3.15E+07	0.00E+00
									Crud						
CO 60	2.18E+01	100.0%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.15	1.24E-10	3.44E-06	3.30E-04	4.76E-09	1.76E+01	3.15E+07	7.84E-05
									Volatiles						
SR 90	5.10E+04	2.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	9.72E-12	3.44E-06	3.30E-04	2.64E-09	9.77E+00	3.15E+07	3.39E-06
RU106	1.44E+04	2.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	2.74E-12	3.44E-06	3.30E-04	1.38E-08	5.11E+01	3.15E+07	5.01E-06
CS134	3.01E+04	2.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	5.74E-12	3.44E-06	3.30E-04	1.30E-08	4.81E+01	3.15E+07	9.87E-06
CS137	7.82E+04	2.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	1.49E-11	3.44E-06	3.30E-04	8.76E-09	3.24E+01	3.15E+07	1.73E-05
									Fines						
PU241	7.75E+04	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	2.22E-13	3.44E-06	3.30E-04	6.82E-07	2.52E+03	3.15E+07	2.00E-05
Y 90	5.10E+04	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.46E-13	3.44E-06	3.30E-04	9.52E-12	3.52E-02	3.15E+07	1.84E-10
PM147	2.57E+04	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	7.35E-14	3.44E-06	3.30E-04	1.86E-14	6.96E-05	3.15E+07	1.83E-13
EU154	4.51E+03	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.29E-14	3.44E-06	3.30E-04	1.17E-08	4.33E+01	3.15E+07	2.00E-08
CM244	5.57E+03	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.59E-14	3.44E-06	3.30E-04	1.59E-05	5.88E+04	3.15E+07	3.35E-05
PU238	3.76E+03	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.07E-14	3.44E-06	3.30E-04	2.80E-05	1.04E+05	3.15E+07	3.98E-05
SB125	1.99E+03	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	5.69E-15	3.44E-06	3.30E-04	3.60E-10	1.33E+00	3.15E+07	2.71E-10
EU155	1.28E+03	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	3.66E-15	3.44E-06	3.30E-04	3.56E-10	1.32E+00	3.15E+07	1.72E-10
AM241	8.06E+02	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	2.30E-15	3.44E-06	3.30E-04	3.25E-05	1.20E+05	3.15E+07	9.91E-06
PU240	3.65E+02	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.04E-15	3.44E-06	3.30E-04	3.18E-05	1.18E+05	3.15E+07	4.39E-06
PU239	1.99E+02	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	5.69E-16	3.44E-06	3.30E-04	3.18E-05	1.18E+05	3.15E+07	2.39E-06
BA137M	7.38E+04	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	2.11E-13	3.44E-06	3.30E-04	0.00E+00	0.00E+00	3.15E+07	0.00E+00
RH106	1.44E+04	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	4.12E-14	3.44E-06	3.30E-04	0.00E+00	0.00E+00	3.15E+07	0.00E+00
CE144	8.14E+03	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	2.33E-14	3.44E-06	3.30E-04	1.93E-09	7.14E+00	3.15E+07	5.94E-09
PR144	8.14E+03	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	2.33E-14	3.44E-06	3.30E-04	2.41E-15	8.92E-06	3.15E+07	7.42E-15
TE125M	4.86E+02	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.39E-15	3.44E-06	3.30E-04	1.24E-10	4.59E-01	3.15E+07	2.28E-11
														Total	2.24E-04

MPC-32															
Normal Conditions															
Committed Effective Dose Equivalent From Inhalation															
Nuclide	Inventory (Ci/Assy)	% available for release	% remain airborne	No. Assy	MPC Vol (cm3)	L_{nor} Rate at Upstream (cm3/s)	Fraction Released per sec	Release Fraction	Release Rate (Ci/sec)	X/Q (sec/m3)	Breathing Rate (m3/sec)	DCF (Sv/Bq)	DCF (mRem/uCi)	Occ Time (sec)	CDE (mRem)
									Gases						
H 3	2.97E+02	2.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.30	8.49E-11	3.44E-06	3.30E-04	1.73E-11	6.40E-02	3.15E+07	1.94E-07
I129	2.64E-02	2.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.30	7.54E-15	3.44E-06	3.30E-04	2.09E-10	7.73E-01	3.15E+07	2.09E-10
KR 85	4.82E+03	2.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.30	1.38E-09	3.44E-06	3.30E-04	0.00E+00	0.00E+00	3.15E+07	0.00E+00
									Crud						
CO 60	2.18E+01	100.0%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.15	1.24E-10	3.44E-06	3.30E-04	1.84E-08	6.81E+01	3.15E+07	3.03E-04
									Volatiles						
SR 90	5.10E+04	2.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	9.72E-12	3.44E-06	3.30E-04	2.64E-09	9.77E+00	3.15E+07	3.39E-06
RU106	1.44E+04	2.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	2.74E-12	3.44E-06	3.30E-04	1.37E-08	5.07E+01	3.15E+07	4.97E-06
CS134	3.01E+04	2.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	5.73E-12	3.44E-06	3.30E-04	1.08E-08	4.00E+01	3.15E+07	8.19E-06
CS137	7.82E+04	2.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	1.49E-11	3.44E-06	3.30E-04	7.84E-09	2.90E+01	3.15E+07	1.55E-05
									Fines						
PU241	7.75E+04	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	2.21E-13	3.44E-06	3.30E-04	3.06E-11	1.13E-01	3.15E+07	8.97E-10
Y 90	5.10E+04	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.46E-13	3.44E-06	3.30E-04	9.52E-12	3.52E-02	3.15E+07	1.84E-10
PM147	2.57E+04	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	7.34E-14	3.44E-06	3.30E-04	3.60E-14	1.33E-04	3.15E+07	3.50E-13
EU154	4.51E+03	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.29E-14	3.44E-06	3.30E-04	1.55E-08	5.74E+01	3.15E+07	2.64E-08
CM244	5.57E+03	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.59E-14	3.44E-06	3.30E-04	1.04E-09	3.85E+00	3.15E+07	2.19E-09
PU238	3.76E+03	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.07E-14	3.44E-06	3.30E-04	1.00E-09	3.70E+00	3.15E+07	1.42E-09
SB125	1.99E+03	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	5.68E-15	3.44E-06	3.30E-04	4.16E-10	1.54E+00	3.15E+07	3.13E-10
EU155	1.28E+03	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	3.66E-15	3.44E-06	3.30E-04	6.14E-10	2.27E+00	3.15E+07	2.97E-10
AM241	8.06E+02	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	2.30E-15	3.44E-06	3.30E-04	2.67E-09	9.88E+00	3.15E+07	8.14E-10
PU240	3.65E+02	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.04E-15	3.44E-06	3.30E-04	9.51E-10	3.52E+00	3.15E+07	1.31E-10
PU239	1.99E+02	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	5.69E-16	3.44E-06	3.30E-04	9.22E-10	3.41E+00	3.15E+07	6.94E-11
BA137M	7.38E+04	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	2.11E-13	3.44E-06	3.30E-04	0.00E+00	0.00E+00	3.15E+07	0.00E+00
RH106	1.44E+04	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	4.11E-14	3.44E-06	3.30E-04	0.00E+00	0.00E+00	3.15E+07	0.00E+00
CE144	8.14E+03	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	2.33E-14	3.44E-06	3.30E-04	1.97E-09	7.29E+00	3.15E+07	6.06E-09
PR144	8.14E+03	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	2.33E-14	3.44E-06	3.30E-04	1.05E-14	3.89E-05	3.15E+07	3.23E-14
TE125M	4.86E+02	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.39E-15	3.44E-06	3.30E-04	1.07E-10	3.96E-01	3.15E+07	1.97E-11
														Total	3.35E-04

MPC-32															
Normal Conditions															
Committed Effective Dose Equivalent From Inhalation															
Nuclide	Inventory (Ci/Assy)	% available for release	% remain airborne	No. Assy	MPC Vol (cm3)	L_{nor} Rate at Upstream (cm3/s)	Fraction Released per sec	Release Fraction	Release Rate (Ci/sec)	X/Q (sec/m3)	Breathing Rate (m3/sec)	DCF (Sv/Bq)	DCF (mRem/uCi)	Occ Time (sec)	CDE (mRem)
									Gases						
H 3	2.97E+02	2.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.30	8.49E-11	3.44E-06	3.30E-04	1.73E-11	6.40E-02	3.15E+07	1.94E-07
I129	2.64E-02	2.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.30	7.54E-15	3.44E-06	3.30E-04	3.14E-10	1.16E+00	3.15E+07	3.13E-10
KR 85	4.82E+03	2.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.30	1.38E-09	3.44E-06	3.30E-04	0.00E+00	0.00E+00	3.15E+07	0.00E+00
									Crud						
CO 60	2.18E+01	100.0%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.15	1.24E-10	3.44E-06	3.30E-04	3.45E-07	1.28E+03	3.15E+07	5.68E-03
									Volatiles						
SR 90	5.10E+04	2.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	9.72E-12	3.44E-06	3.30E-04	2.86E-06	1.06E+04	3.15E+07	3.68E-03
RU106	1.44E+04	2.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	2.74E-12	3.44E-06	3.30E-04	1.04E-06	3.85E+03	3.15E+07	3.77E-04
CS134	3.01E+04	2.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	5.73E-12	3.44E-06	3.30E-04	1.18E-08	4.37E+01	3.15E+07	8.95E-06
CS137	7.82E+04	2.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	1.49E-11	3.44E-06	3.30E-04	8.82E-09	3.26E+01	3.15E+07	1.74E-05
									Fines						
PU241	7.75E+04	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	2.21E-13	3.44E-06	3.30E-04	3.18E-06	1.18E+04	3.15E+07	9.32E-05
Y 90	5.10E+04	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.46E-13	3.44E-06	3.30E-04	9.31E-09	3.44E+01	3.15E+07	1.80E-07
PM147	2.57E+04	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	7.34E-14	3.44E-06	3.30E-04	7.74E-08	2.86E+02	3.15E+07	7.52E-07
EU154	4.51E+03	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.29E-14	3.44E-06	3.30E-04	7.92E-08	2.93E+02	3.15E+07	1.35E-07
CM244	5.57E+03	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.59E-14	3.44E-06	3.30E-04	1.93E-05	7.14E+04	3.15E+07	4.06E-05
PU238	3.76E+03	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.07E-14	3.44E-06	3.30E-04	3.20E-04	1.18E+06	3.15E+07	4.55E-04
SB125	1.99E+03	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	5.68E-15	3.44E-06	3.30E-04	2.17E-08	8.03E+01	3.15E+07	1.63E-08
EU155	1.28E+03	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	3.66E-15	3.44E-06	3.30E-04	1.19E-08	4.40E+01	3.15E+07	5.76E-09
AM241	8.06E+02	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	2.30E-15	3.44E-06	3.30E-04	1.84E-05	6.81E+04	3.15E+07	5.61E-06
PU240	3.65E+02	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.04E-15	3.44E-06	3.30E-04	3.23E-04	1.20E+06	3.15E+07	4.46E-05
PU239	1.99E+02	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	5.69E-16	3.44E-06	3.30E-04	1.73E-05	6.40E+04	3.15E+07	1.30E-06
BA137M	7.38E+04	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	2.11E-13	3.44E-06	3.30E-04	0.00E+00	0.00E+00	3.15E+07	0.00E+00
RH106	1.44E+04	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	4.11E-14	3.44E-06	3.30E-04	0.00E+00	0.00E+00	3.15E+07	0.00E+00
CE144	8.14E+03	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	2.33E-14	3.44E-06	3.30E-04	7.91E-07	2.93E+03	3.15E+07	2.43E-06
PR144	8.14E+03	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	2.33E-14	3.44E-06	3.30E-04	9.40E-11	3.48E-01	3.15E+07	2.89E-10
TE125M	4.86E+02	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.39E-15	3.44E-06	3.30E-04	1.04E-08	3.85E+01	3.15E+07	1.91E-09
														Total	1.04E-02

MPC-32															
Normal Conditions															
Committed Effective Dose Equivalent From Inhalation															
Nuclide	Inventory (Ci/Assy)	% available for release	% remain airborne	No. Assy	MPC Vol (cm3)	L_{nor} Rate at Upstream (cm3/s)	Fraction Released per sec	Release Fraction	Release Rate (Ci/sec)	X/Q (sec/m3)	Breathing Rate (m3/sec)	DCF (Sv/Bq)	DCF (mRem/uCi)	Occ Time (sec)	CDE (mRem)
									Gases						
H 3	2.97E+02	2.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.30	8.49E-11	3.44E-06	3.30E-04	1.73E-11	6.40E-02	3.15E+07	1.94E-07
I129	2.64E-02	2.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.30	7.54E-15	3.44E-06	3.30E-04	1.40E-10	5.18E-01	3.15E+07	1.40E-10
KR 85	4.82E+03	2.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.30	1.38E-09	3.44E-06	3.30E-04	0.00E+00	0.00E+00	3.15E+07	0.00E+00
									Crud						
CO 60	2.18E+01	100.0%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.15	1.24E-10	3.44E-06	3.30E-04	1.72E-08	6.36E+01	3.15E+07	2.83E-04
									Volatiles						
SR 90	5.10E+04	2.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	9.72E-12	3.44E-06	3.30E-04	3.36E-07	1.24E+03	3.15E+07	4.32E-04
RU106	1.44E+04	2.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	2.74E-12	3.44E-06	3.30E-04	1.37E-08	5.07E+01	3.15E+07	4.97E-06
CS134	3.01E+04	2.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	5.73E-12	3.44E-06	3.30E-04	1.18E-08	4.37E+01	3.15E+07	8.95E-06
CS137	7.82E+04	2.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	1.49E-11	3.44E-06	3.30E-04	8.30E-09	3.07E+01	3.15E+07	1.64E-05
									Fines						
PU241	7.75E+04	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	2.21E-13	3.44E-06	3.30E-04	3.36E-06	1.24E+04	3.15E+07	9.84E-05
Y 90	5.10E+04	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.46E-13	3.44E-06	3.30E-04	2.79E-10	1.03E+00	3.15E+07	5.38E-09
PM147	2.57E+04	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	7.34E-14	3.44E-06	3.30E-04	8.16E-09	3.02E+01	3.15E+07	7.93E-08
EU154	4.51E+03	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.29E-14	3.44E-06	3.30E-04	1.06E-07	3.92E+02	3.15E+07	1.81E-07
CM244	5.57E+03	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.59E-14	3.44E-06	3.30E-04	9.38E-05	3.47E+05	3.15E+07	1.98E-04
PU238	3.76E+03	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.07E-14	3.44E-06	3.30E-04	1.52E-04	5.62E+05	3.15E+07	2.16E-04
SB125	1.99E+03	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	5.68E-15	3.44E-06	3.30E-04	6.49E-10	2.40E+00	3.15E+07	4.88E-10
EU155	1.28E+03	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	3.66E-15	3.44E-06	3.30E-04	1.43E-08	5.29E+01	3.15E+07	6.92E-09
AM241	8.06E+02	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	2.30E-15	3.44E-06	3.30E-04	1.74E-04	6.44E+05	3.15E+07	5.30E-05
PU240	3.65E+02	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.04E-15	3.44E-06	3.30E-04	1.69E-04	6.25E+05	3.15E+07	2.33E-05
PU239	1.99E+02	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	5.69E-16	3.44E-06	3.30E-04	1.69E-04	6.25E+05	3.15E+07	1.27E-05
BA137M	7.38E+04	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	2.11E-13	3.44E-06	3.30E-04	0.00E+00	0.00E+00	3.15E+07	0.00E+00
RH106	1.44E+04	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	4.11E-14	3.44E-06	3.30E-04	0.00E+00	0.00E+00	3.15E+07	0.00E+00
CE144	8.14E+03	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	2.33E-14	3.44E-06	3.30E-04	2.67E-08	9.88E+01	3.15E+07	8.22E-08
PR144	8.14E+03	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	2.33E-14	3.44E-06	3.30E-04	8.08E-14	2.99E-04	3.15E+07	2.49E-13
TE125M	4.86E+02	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.39E-15	3.44E-06	3.30E-04	3.01E-09	1.11E+01	3.15E+07	5.54E-10
														Total	1.35E-03

MPC-32 Normal Conditions Committed Effective Dose Equivalent From Inhalation															
Nuclide	Inventory (Ci/Assy)	% available for release	% remain airborne	No. Assy	MPC Vol (cm3)	L_{nor} Rate at Upstream (cm3/s)	Fraction Released per sec	Release Fraction	Release Rate (Ci/sec)	X/Q (sec/m3)	Breathing Rate (m3/sec)	DCF (Sv/Bq)	DCF (mRem/uCi)	Occ Time (sec)	CDE (mRem)
									Gases						
H 3	2.97E+02	2.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.30	8.49E-11	3.44E-06	3.30E-04	1.73E-11	6.40E-02	3.15E+07	1.94E-07
I129	2.64E-02	2.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.30	7.54E-15	3.44E-06	3.30E-04	1.38E-10	5.11E-01	3.15E+07	1.38E-10
KR 85	4.82E+03	2.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.30	1.38E-09	3.44E-06	3.30E-04	0.00E+00	0.00E+00	3.15E+07	0.00E+00
									Crud						
CO 60	2.18E+01	100.0%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.15	1.24E-10	3.44E-06	3.30E-04	1.35E-08	5.00E+01	3.15E+07	2.22E-04
									Volatiles						
SR 90	5.10E+04	2.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	9.72E-12	3.44E-06	3.30E-04	7.27E-07	2.69E+03	3.15E+07	9.35E-04
RU106	1.44E+04	2.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	2.74E-12	3.44E-06	3.30E-04	1.37E-08	5.07E+01	3.15E+07	4.97E-06
CS134	3.01E+04	2.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	5.73E-12	3.44E-06	3.30E-04	1.10E-08	4.07E+01	3.15E+07	8.35E-06
CS137	7.82E+04	2.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	1.49E-11	3.44E-06	3.30E-04	7.94E-09	2.94E+01	3.15E+07	1.56E-05
									Fines						
PU241	7.75E+04	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	2.21E-13	3.44E-06	3.30E-04	4.20E-05	1.55E+05	3.15E+07	1.23E-03
Y 90	5.10E+04	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.46E-13	3.44E-06	3.30E-04	2.78E-10	1.03E+00	3.15E+07	5.36E-09
PM147	2.57E+04	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	7.34E-14	3.44E-06	3.30E-04	1.02E-07	3.77E+02	3.15E+07	9.91E-07
EU154	4.51E+03	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.29E-14	3.44E-06	3.30E-04	5.23E-07	1.94E+03	3.15E+07	8.92E-07
CM244	5.57E+03	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.59E-14	3.44E-06	3.30E-04	1.17E-03	4.33E+06	3.15E+07	2.46E-03
PU238	3.76E+03	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.07E-14	3.44E-06	3.30E-04	1.90E-03	7.03E+06	3.15E+07	2.70E-03
SB125	1.99E+03	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	5.68E-15	3.44E-06	3.30E-04	2.73E-09	1.01E+01	3.15E+07	2.05E-09
EU155	1.28E+03	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	3.66E-15	3.44E-06	3.30E-04	1.52E-07	5.62E+02	3.15E+07	7.36E-08
AM241	8.06E+02	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	2.30E-15	3.44E-06	3.30E-04	2.17E-03	8.03E+06	3.15E+07	6.61E-04
PU240	3.65E+02	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.04E-15	3.44E-06	3.30E-04	2.11E-03	7.81E+06	3.15E+07	2.91E-04
PU239	1.99E+02	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	5.69E-16	3.44E-06	3.30E-04	2.11E-03	7.81E+06	3.15E+07	1.59E-04
BA137M	7.38E+04	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	2.11E-13	3.44E-06	3.30E-04	0.00E+00	0.00E+00	3.15E+07	0.00E+00
RH106	1.44E+04	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	4.11E-14	3.44E-06	3.30E-04	0.00E+00	0.00E+00	3.15E+07	0.00E+00
CE144	8.14E+03	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	2.33E-14	3.44E-06	3.30E-04	4.54E-08	1.68E+02	3.15E+07	1.40E-07
PR144	8.14E+03	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	2.33E-14	3.44E-06	3.30E-04	1.35E-13	5.00E-04	3.15E+07	4.15E-13
TE125M	4.86E+02	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.39E-15	3.44E-06	3.30E-04	3.21E-08	1.19E+02	3.15E+07	5.90E-09
														Total	8.69E-03

MPC-32

Normal Conditions

Committed Effective Dose Equivalent From Inhalation

Nuclide	Inventory (Ci/Assy)	% available for release	% remain airborne	No. Assy	MPC Vol (cm3)	L_{nor} Rate at Upstream (cm3/s)	Fraction Released per sec	Release Fraction	Release Rate (Ci/sec)	X/Q (sec/m3)	Breathing Rate (m3/sec)	DCF (Sv/Bq)	DCF (mRem/uCi)	Occ Time (sec)	CDE (mRem)
									Gases						
H 3	2.97E+02	2.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.30	8.49E-11	3.44E-06	3.30E-04	1.73E-11	6.40E-02	3.15E+07	1.94E-07
I129	2.64E-02	2.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.30	7.54E-15	3.44E-06	3.30E-04	1.56E-06	5.77E+03	3.15E+07	1.56E-06
KR 85	4.82E+03	2.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.30	1.38E-09	3.44E-06	3.30E-04	0.00E+00	0.00E+00	3.15E+07	0.00E+00
									Crud						
CO 60	2.18E+01	100.0%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.15	1.24E-10	3.44E-06	3.30E-04	1.62E-08	5.99E+01	3.15E+07	2.67E-04
									Volatiles						
SR 90	5.10E+04	2.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	9.72E-12	3.44E-06	3.30E-04	2.64E-09	9.77E+00	3.15E+07	3.39E-06
RU106	1.44E+04	2.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	2.74E-12	3.44E-06	3.30E-04	1.37E-08	5.07E+01	3.15E+07	4.97E-06
CS134	3.01E+04	2.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	5.73E-12	3.44E-06	3.30E-04	1.11E-08	4.11E+01	3.15E+07	8.42E-06
CS137	7.82E+04	2.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	1.49E-11	3.44E-06	3.30E-04	7.93E-09	2.93E+01	3.15E+07	1.56E-05
									Fines						
PU241	7.75E+04	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	2.21E-13	3.44E-06	3.30E-04	1.24E-11	4.59E-02	3.15E+07	3.63E-10
Y 90	5.10E+04	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.46E-13	3.44E-06	3.30E-04	9.52E-12	3.52E-02	3.15E+07	1.84E-10
PM147	2.57E+04	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	7.34E-14	3.44E-06	3.30E-04	1.98E-14	7.33E-05	3.15E+07	1.92E-13
EU154	4.51E+03	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.29E-14	3.44E-06	3.30E-04	7.14E-09	2.64E+01	3.15E+07	1.22E-08
CM244	5.57E+03	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.59E-14	3.44E-06	3.30E-04	1.01E-09	3.74E+00	3.15E+07	2.13E-09
PU238	3.76E+03	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.07E-14	3.44E-06	3.30E-04	9.62E-10	3.56E+00	3.15E+07	1.37E-09
SB125	1.99E+03	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	5.68E-15	3.44E-06	3.30E-04	3.24E-10	1.20E+00	3.15E+07	2.44E-10
EU155	1.28E+03	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	3.66E-15	3.44E-06	3.30E-04	2.40E-10	8.88E-01	3.15E+07	1.16E-10
AM241	8.06E+02	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	2.30E-15	3.44E-06	3.30E-04	1.60E-09	5.92E+00	3.15E+07	4.88E-10
PU240	3.65E+02	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.04E-15	3.44E-06	3.30E-04	9.05E-10	3.35E+00	3.15E+07	1.25E-10
PU239	1.99E+02	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	5.69E-16	3.44E-06	3.30E-04	9.03E-10	3.34E+00	3.15E+07	6.79E-11
BA137M	7.38E+04	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	2.11E-13	3.44E-06	3.30E-04	0.00E+00	0.00E+00	3.15E+07	0.00E+00
RH106	1.44E+04	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	4.11E-14	3.44E-06	3.30E-04	0.00E+00	0.00E+00	3.15E+07	0.00E+00
CE144	8.14E+03	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	2.33E-14	3.44E-06	3.30E-04	1.88E-09	6.96E+00	3.15E+07	5.79E-09
PR144	8.14E+03	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	2.33E-14	3.44E-06	3.30E-04	8.47E-15	3.13E-05	3.15E+07	2.61E-14
TE125M	4.86E+02	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.39E-15	3.44E-06	3.30E-04	9.93E-11	3.67E-01	3.15E+07	1.83E-11
														Total	3.01E-04

MPC-32															
Normal Conditions															
Committed Effective Dose Equivalent From Inhalation															
Nuclide	Inventory (Ci/Assy)	% available for release	% remain airborne	No. Assy	MPC Vol (cm3)	L_{nor} Rate at Upstream (cm3/s)	Fraction Released per sec	Release Fraction	Release Rate (Ci/sec)	X/Q (sec/m3)	Breathing Rate (m3/sec)	DCF (Sv/Bq)	DCF (mRem/uCi)	Occ Time (sec)	CEDE (mRem)
									Gases						
H 3	2.97E+02	2.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.30	8.49E-11	3.44E-06	3.30E-04	1.73E-11	6.40E-02	3.15E+07	1.94E-07
I129	2.64E-02	2.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.30	7.54E-15	3.44E-06	3.30E-04	4.69E-08	1.74E+02	3.15E+07	4.68E-08
KR 85	4.82E+03	2.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.30	1.38E-09	3.44E-06	3.30E-04	0.00E+00	0.00E+00	3.15E+07	0.00E+00
									Crud						
CO 60	2.18E+01	100.0%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.15	1.24E-10	3.44E-06	3.30E-04	5.91E-08	2.19E+02	3.15E+07	9.73E-04
									Volatiles						
SR 90	5.10E+04	2.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	9.72E-12	3.44E-06	3.30E-04	3.51E-07	1.30E+03	3.15E+07	4.51E-04
RU106	1.44E+04	2.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	2.74E-12	3.44E-06	3.30E-04	1.29E-07	4.77E+02	3.15E+07	4.68E-05
CS134	3.01E+04	2.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	5.73E-12	3.44E-06	3.30E-04	1.25E-08	4.63E+01	3.15E+07	9.48E-06
CS137	7.82E+04	2.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	1.49E-11	3.44E-06	3.30E-04	8.63E-09	3.19E+01	3.15E+07	1.70E-05
									Fines						
PU241	7.75E+04	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	2.21E-13	3.44E-06	3.30E-04	2.23E-06	8.25E+03	3.15E+07	6.53E-05
Y 90	5.10E+04	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.46E-13	3.44E-06	3.30E-04	2.28E-09	8.44E+00	3.15E+07	4.40E-08
PM147	2.57E+04	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	7.34E-14	3.44E-06	3.30E-04	1.06E-08	3.92E+01	3.15E+07	1.03E-07
EU154	4.51E+03	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.29E-14	3.44E-06	3.30E-04	7.73E-08	2.86E+02	3.15E+07	1.32E-07
CM244	5.57E+03	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.59E-14	3.44E-06	3.30E-04	6.70E-05	2.48E+05	3.15E+07	1.41E-04
PU238	3.76E+03	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.07E-14	3.44E-06	3.30E-04	1.06E-04	3.92E+05	3.15E+07	1.51E-04
SB125	1.99E+03	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	5.68E-15	3.44E-06	3.30E-04	3.30E-09	1.22E+01	3.15E+07	2.48E-09
EU155	1.28E+03	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	3.66E-15	3.44E-06	3.30E-04	1.12E-08	4.14E+01	3.15E+07	5.42E-09
AM241	8.06E+02	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	2.30E-15	3.44E-06	3.30E-04	1.20E-04	4.44E+05	3.15E+07	3.66E-05
PU240	3.65E+02	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.04E-15	3.44E-06	3.30E-04	1.16E-04	4.29E+05	3.15E+07	1.60E-05
PU239	1.99E+02	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	5.69E-16	3.44E-06	3.30E-04	1.16E-04	4.29E+05	3.15E+07	8.73E-06
BA137M	7.38E+04	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	2.11E-13	3.44E-06	3.30E-04	0.00E+00	0.00E+00	3.15E+07	0.00E+00
RH106	1.44E+04	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	4.11E-14	3.44E-06	3.30E-04	0.00E+00	0.00E+00	3.15E+07	0.00E+00
CE144	8.14E+03	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	2.33E-14	3.44E-06	3.30E-04	5.84E-08	2.16E+02	3.15E+07	1.80E-07
PR144	8.14E+03	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	2.33E-14	3.44E-06	3.30E-04	1.17E-11	4.33E-02	3.15E+07	3.60E-11
TE125M	4.86E+02	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.39E-15	3.44E-06	3.30E-04	1.52E-09	5.62E+00	3.15E+07	2.80E-10
														Total	1.92E-03

MPC-32														
Normal Conditions														
Effective Dose Equivalent From Submersion														
Nuclide	Inventory (Ci/Assy)	% available for release	% remain airborne	No. Assy	MPC Vol (cm3)	L_{nor} Rate at Upstream (cm3/s)	Fraction Released per sec	Release Fraction	Release Rate (Ci/sec)	X/Q (sec/m3)	DCF (Sv/Bq)	DCF (mRem/uCi)	Occ Time (sec)	DDE (mRem)
									Gases					
H 3	2.97E+02	2.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.30	8.49E-11	3.44E-06	0.00E+00	0.00E+00	3.15E+07	0.00E+00
I129	2.64E-02	2.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.30	7.55E-15	3.44E-06	4.83E-16	1.79E-06	3.15E+07	1.46E-12
KR 85	4.82E+03	2.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.30	1.38E-09	3.44E-06	1.17E-16	4.33E-07	3.15E+07	6.46E-08
									Crud					
CO 60	2.18E+01	100.0%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.15	1.24E-10	3.44E-06	1.23E-13	4.55E-04	3.15E+07	6.14E-06
									Volatiles					
SR 90	5.10E+04	2.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	9.72E-12	3.44E-06	7.78E-18	2.88E-08	3.15E+07	3.03E-11
RU106	1.44E+04	2.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	2.74E-12	3.44E-06	0.00E+00	0.00E+00	3.15E+07	0.00E+00
CS134	3.01E+04	2.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	5.74E-12	3.44E-06	7.40E-14	2.74E-04	3.15E+07	1.70E-07
CS137	7.82E+04	2.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	1.49E-11	3.44E-06	7.96E-18	2.95E-08	3.15E+07	4.76E-11
									Fines					
PU241	7.75E+04	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	2.22E-13	3.44E-06	7.19E-20	2.66E-10	3.15E+07	6.39E-15
Y 90	5.10E+04	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.46E-13	3.44E-06	1.89E-16	6.99E-07	3.15E+07	1.10E-11
PM147	2.57E+04	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	7.35E-14	3.44E-06	7.48E-19	2.77E-09	3.15E+07	2.20E-14
EU154	4.51E+03	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.29E-14	3.44E-06	6.00E-14	2.22E-04	3.15E+07	3.10E-10
CM244	5.57E+03	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.59E-14	3.44E-06	6.90E-18	2.55E-08	3.15E+07	4.40E-14
PU238	3.76E+03	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.07E-14	3.44E-06	6.56E-18	2.43E-08	3.15E+07	2.83E-14
SB125	1.99E+03	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	5.69E-15	3.44E-06	1.98E-14	7.33E-05	3.15E+07	4.51E-11
EU155	1.28E+03	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	3.66E-15	3.44E-06	2.49E-15	9.21E-06	3.15E+07	3.65E-12
AM241	8.06E+02	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	2.30E-15	3.44E-06	8.58E-16	3.17E-06	3.15E+07	7.93E-13
PU240	3.65E+02	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.04E-15	3.44E-06	6.36E-18	2.35E-08	3.15E+07	2.66E-15
PU239	1.99E+02	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	5.69E-16	3.44E-06	4.84E-18	1.79E-08	3.15E+07	1.10E-15
BA137M	7.38E+04	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	2.11E-13	3.44E-06	2.82E-14	1.04E-04	3.15E+07	2.39E-09
RH106	1.44E+04	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	4.12E-14	3.44E-06	1.01E-14	3.74E-05	3.15E+07	1.67E-10
CE144	8.14E+03	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	2.33E-14	3.44E-06	8.53E-16	3.16E-06	3.15E+07	7.96E-12
PR144	8.14E+03	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	2.33E-14	3.44E-06	1.90E-15	7.03E-06	3.15E+07	1.77E-11
TE125M	4.86E+02	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.39E-15	3.44E-06	5.96E-16	2.21E-06	3.15E+07	3.32E-13
													Total	6.38E-06

MPC-32														
Normal Conditions														
Effective Dose Equivalent From Submersion														
Nuclide	Inventory (Ci/Assy)	% available for release	% remain airborne	No. Assy	MPC Vol (cm3)	L_{nor} Rate at Upstream (cm3/s)	Fraction Released per sec	Release Fraction	Release Rate (Ci/sec)	X/Q (sec/m3)	DCF (Sv/Bq)	DCF (mRem/uCi)	Occ Time (sec)	DDE (mRem)
									Gases					
H 3	2.97E+02	2.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.30	8.49E-11	3.44E-06	0.00E+00	0.00E+00	3.15E+07	0.00E+00
I129	2.64E-02	2.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.30	7.55E-15	3.44E-06	6.66E-16	2.46E-06	3.15E+07	2.02E-12
KR 85	4.82E+03	2.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.30	1.38E-09	3.44E-06	1.34E-16	4.96E-07	3.15E+07	7.40E-08
									Crud					
CO 60	2.18E+01	100.0%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.15	1.24E-10	3.44E-06	1.39E-13	5.14E-04	3.15E+07	6.94E-06
									Volatiles					
SR 90	5.10E+04	2.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	9.72E-12	3.44E-06	9.49E-18	3.51E-08	3.15E+07	3.70E-11
RU106	1.44E+04	2.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	2.74E-12	3.44E-06	0.00E+00	0.00E+00	3.15E+07	0.00E+00
CS134	3.01E+04	2.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	5.74E-12	3.44E-06	8.43E-14	3.12E-04	3.15E+07	1.94E-07
CS137	7.82E+04	2.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	1.49E-11	3.44E-06	9.67E-18	3.58E-08	3.15E+07	5.78E-11
									Fines					
PU241	7.75E+04	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	2.22E-13	3.44E-06	8.67E-20	3.21E-10	3.15E+07	7.70E-15
Y 90	5.10E+04	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.46E-13	3.44E-06	2.20E-16	8.14E-07	3.15E+07	1.29E-11
PM147	2.57E+04	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	7.35E-14	3.44E-06	9.56E-19	3.54E-09	3.15E+07	2.82E-14
EU154	4.51E+03	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.29E-14	3.44E-06	6.81E-14	2.52E-04	3.15E+07	3.52E-10
CM244	5.57E+03	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.59E-14	3.44E-06	1.33E-17	4.92E-08	3.15E+07	8.49E-14
PU238	3.76E+03	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.07E-14	3.44E-06	1.27E-17	4.70E-08	3.15E+07	5.47E-14
SB125	1.99E+03	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	5.69E-15	3.44E-06	2.27E-14	8.40E-05	3.15E+07	5.17E-11
EU155	1.28E+03	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	3.66E-15	3.44E-06	2.95E-15	1.09E-05	3.15E+07	4.33E-12
AM241	8.06E+02	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	2.30E-15	3.44E-06	1.07E-15	3.96E-06	3.15E+07	9.88E-13
PU240	3.65E+02	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.04E-15	3.44E-06	1.23E-17	4.55E-08	3.15E+07	5.15E-15
PU239	1.99E+02	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	5.69E-16	3.44E-06	7.55E-18	2.79E-08	3.15E+07	1.72E-15
BA137M	7.38E+04	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	2.11E-13	3.44E-06	3.22E-14	1.19E-04	3.15E+07	2.72E-09
RH106	1.44E+04	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	4.12E-14	3.44E-06	1.16E-14	4.29E-05	3.15E+07	1.91E-10
CE144	8.14E+03	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	2.33E-14	3.44E-06	1.01E-15	3.74E-06	3.15E+07	9.42E-12
PR144	8.14E+03	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	2.33E-14	3.44E-06	2.15E-15	7.96E-06	3.15E+07	2.01E-11
TE125M	4.86E+02	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.39E-15	3.44E-06	8.48E-16	3.14E-06	3.15E+07	4.73E-13
													Total	7.21E-06

MPC-32														
Normal Conditions														
Effective Dose Equivalent From Submersion														
Nuclide	Inventory (Ci/Assy)	% available for release	% remain airborne	No. Assy	MPC Vol (cm3)	L_{nor} Rate at Upstream (cm3/s)	Fraction Released per sec	Release Fraction	Release Rate (Ci/sec)	X/Q (sec/m3)	DCF (Sv/Bq)	DCF (mRem/uCi)	Occ Time (sec)	DDE (mRem)
									Gases					
H 3	2.97E+02	2.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.30	8.49E-11	3.44E-06	2.75E-18	1.02E-08	3.15E+07	9.36E-11
I129	2.64E-02	2.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.30	7.55E-15	3.44E-06	2.14E-16	7.92E-07	3.15E+07	6.48E-13
KR 85	4.82E+03	2.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.30	1.38E-09	3.44E-06	1.14E-16	4.22E-07	3.15E+07	6.30E-08
									Crud					
CO 60	2.18E+01	100.0%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.15	1.24E-10	3.44E-06	1.24E-13	4.59E-04	3.15E+07	6.19E-06
									Volatiles					
SR 90	5.10E+04	2.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	9.72E-12	3.44E-06	6.44E-18	2.38E-08	3.15E+07	2.51E-11
RU106	1.44E+04	2.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	2.74E-12	3.44E-06	0.00E+00	0.00E+00	3.15E+07	0.00E+00
CS134	3.01E+04	2.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	5.74E-12	3.44E-06	7.37E-14	2.73E-04	3.15E+07	1.70E-07
CS137	7.82E+04	2.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	1.49E-11	3.44E-06	6.68E-18	2.47E-08	3.15E+07	3.99E-11
									Fines					
PU241	7.75E+04	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	2.22E-13	3.44E-06	6.48E-20	2.40E-10	3.15E+07	5.76E-15
Y 90	5.10E+04	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.46E-13	3.44E-06	1.77E-16	6.55E-07	3.15E+07	1.03E-11
PM147	2.57E+04	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	7.35E-14	3.44E-06	5.45E-19	2.02E-09	3.15E+07	1.61E-14
EU154	4.51E+03	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.29E-14	3.44E-06	5.99E-14	2.22E-04	3.15E+07	3.10E-10
CM244	5.57E+03	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.59E-14	3.44E-06	7.08E-19	2.62E-09	3.15E+07	4.52E-15
PU238	3.76E+03	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.07E-14	3.44E-06	1.06E-18	3.92E-09	3.15E+07	4.57E-15
SB125	1.99E+03	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	5.69E-15	3.44E-06	1.95E-14	7.22E-05	3.15E+07	4.45E-11
EU155	1.28E+03	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	3.66E-15	3.44E-06	2.22E-15	8.21E-06	3.15E+07	3.26E-12
AM241	8.06E+02	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	2.30E-15	3.44E-06	6.74E-16	2.49E-06	3.15E+07	6.23E-13
PU240	3.65E+02	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.04E-15	3.44E-06	1.09E-18	4.03E-09	3.15E+07	4.56E-16
PU239	1.99E+02	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	5.69E-16	3.44E-06	2.65E-18	9.81E-09	3.15E+07	6.04E-16
BA137M	7.38E+04	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	2.11E-13	3.44E-06	2.80E-14	1.04E-04	3.15E+07	2.37E-09
RH106	1.44E+04	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	4.12E-14	3.44E-06	1.01E-14	3.74E-05	3.15E+07	1.67E-10
CE144	8.14E+03	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	2.33E-14	3.44E-06	7.69E-16	2.85E-06	3.15E+07	7.17E-12
PR144	8.14E+03	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	2.33E-14	3.44E-06	1.90E-15	7.03E-06	3.15E+07	1.77E-11
TE125M	4.86E+02	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.39E-15	3.44E-06	2.23E-16	8.25E-07	3.15E+07	1.24E-13
													Total	6.42E-06

MPC-32 Normal Conditions Effective Dose Equivalent From Submersion														
Nuclide	Inventory (Ci/Assy)	% available for release	% remain airborne	No. Assy	MPC Vol (cm3)	L_{nor} Rate at Upstream (cm3/s)	Fraction Released per sec	Release Fraction	Release Rate (Ci/sec)	X/Q (sec/m3)	DCF (Sv/Bq)	DCF (mRem/uCi)	Occ Time (sec)	DDE (mRem)
									Gases					
H 3	2.97E+02	2.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.30	8.49E-11	3.44E-06	0.00E+00	0.00E+00	3.15E+07	0.00E+00
I129	2.64E-02	2.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.30	7.55E-15	3.44E-06	1.64E-16	6.07E-07	3.15E+07	4.96E-13
KR 85	4.82E+03	2.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.30	1.38E-09	3.44E-06	1.09E-16	4.03E-07	3.15E+07	6.02E-08
									Crud					
CO 60	2.18E+01	100.0%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.15	1.24E-10	3.44E-06	1.23E-13	4.55E-04	3.15E+07	6.14E-06
									Volatiles					
SR 90	5.10E+04	2.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	9.72E-12	3.44E-06	5.44E-18	2.01E-08	3.15E+07	2.12E-11
RU106	1.44E+04	2.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	2.74E-12	3.44E-06	0.00E+00	0.00E+00	3.15E+07	0.00E+00
CS134	3.01E+04	2.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	5.74E-12	3.44E-06	7.19E-14	2.66E-04	3.15E+07	1.65E-07
CS137	7.82E+04	2.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	1.49E-11	3.44E-06	5.70E-18	2.11E-08	3.15E+07	3.41E-11
									Fines					
PU241	7.75E+04	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	2.22E-13	3.44E-06	5.63E-20	2.08E-10	3.15E+07	5.00E-15
Y 90	5.10E+04	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.46E-13	3.44E-06	1.62E-16	5.99E-07	3.15E+07	9.47E-12
PM147	2.57E+04	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	7.35E-14	3.44E-06	4.46E-19	1.65E-09	3.15E+07	1.31E-14
EU154	4.51E+03	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.29E-14	3.44E-06	5.87E-14	2.17E-04	3.15E+07	3.03E-10
CM244	5.57E+03	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.59E-14	3.44E-06	1.46E-18	5.40E-09	3.15E+07	9.32E-15
PU238	3.76E+03	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.07E-14	3.44E-06	1.68E-18	6.22E-09	3.15E+07	7.24E-15
SB125	1.99E+03	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	5.69E-15	3.44E-06	1.87E-14	6.92E-05	3.15E+07	4.26E-11
EU155	1.28E+03	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	3.66E-15	3.44E-06	1.85E-15	6.85E-06	3.15E+07	2.71E-12
AM241	8.06E+02	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	2.30E-15	3.44E-06	5.21E-16	1.93E-06	3.15E+07	4.81E-13
PU240	3.65E+02	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.04E-15	3.44E-06	1.65E-18	6.11E-09	3.15E+07	6.90E-16
PU239	1.99E+02	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	5.69E-16	3.44E-06	2.67E-18	9.88E-09	3.15E+07	6.09E-16
BA137M	7.38E+04	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	2.11E-13	3.44E-06	2.73E-14	1.01E-04	3.15E+07	2.31E-09
RH106	1.44E+04	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	4.12E-14	3.44E-06	9.75E-15	3.61E-05	3.15E+07	1.61E-10
CE144	8.14E+03	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	2.33E-14	3.44E-06	6.68E-16	2.47E-06	3.15E+07	6.23E-12
PR144	8.14E+03	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	2.33E-14	3.44E-06	1.87E-15	6.92E-06	3.15E+07	1.74E-11
TE125M	4.86E+02	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.39E-15	3.44E-06	1.86E-16	6.88E-07	3.15E+07	1.04E-13
													Total	6.37E-06

Sub-B Surface

MPC-32 Normal Conditions Effective Dose Equivalent From Submersion														
Nuclide	Inventory (Ci/Assy)	% available for release	% remain airborne	No. Assy	MPC Vol (cm3)	L_{nor} Rate at Upstream (cm3/s)	Fraction Released per sec	Release Fraction	Release Rate (Ci/sec)	X/Q (sec/m3)	DCF (Sv/Bq)	DCF (mRem/uCi)	Occ Time (sec)	DDE (mRem)
									Gases					
H 3	2.97E+02	2.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.30	8.49E-11	3.44E-06	0.00E+00	0.00E+00	3.15E+07	0.00E+00
I129	2.64E-02	2.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.30	7.55E-15	3.44E-06	1.10E-15	4.07E-06	3.15E+07	3.33E-12
KR 85	4.82E+03	2.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.30	1.38E-09	3.44E-06	2.20E-16	8.14E-07	3.15E+07	1.22E-07
									Crud					
CO 60	2.18E+01	100.0%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.15	1.24E-10	3.44E-06	1.78E-13	6.59E-04	3.15E+07	8.88E-06
									Volatiles					
SR 90	5.10E+04	2.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	9.72E-12	3.44E-06	2.28E-17	8.44E-08	3.15E+07	8.88E-11
RU106	1.44E+04	2.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	2.74E-12	3.44E-06	0.00E+00	0.00E+00	3.15E+07	0.00E+00
CS134	3.01E+04	2.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	5.74E-12	3.44E-06	1.20E-13	4.44E-04	3.15E+07	2.76E-07
CS137	7.82E+04	2.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	1.49E-11	3.44E-06	2.29E-17	8.47E-08	3.15E+07	1.37E-10
									Fines					
PU241	7.75E+04	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	2.22E-13	3.44E-06	2.19E-19	8.10E-10	3.15E+07	1.95E-14
Y 90	5.10E+04	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.46E-13	3.44E-06	4.44E-16	1.64E-06	3.15E+07	2.60E-11
PM147	2.57E+04	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	7.35E-14	3.44E-06	2.18E-18	8.07E-09	3.15E+07	6.42E-14
EU154	4.51E+03	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.29E-14	3.44E-06	9.43E-14	3.49E-04	3.15E+07	4.87E-10
CM244	5.57E+03	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.59E-14	3.44E-06	8.82E-18	3.26E-08	3.15E+07	5.63E-14
PU238	3.76E+03	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.07E-14	3.44E-06	9.30E-18	3.44E-08	3.15E+07	4.01E-14
SB125	1.99E+03	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	5.69E-15	3.44E-06	3.53E-14	1.31E-04	3.15E+07	8.05E-11
EU155	1.28E+03	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	3.66E-15	3.44E-06	8.09E-15	2.99E-05	3.15E+07	1.19E-11
AM241	8.06E+02	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	2.30E-15	3.44E-06	2.87E-15	1.06E-05	3.15E+07	2.65E-12
PU240	3.65E+02	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.04E-15	3.44E-06	9.26E-18	3.43E-08	3.15E+07	3.87E-15
PU239	1.99E+02	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	5.69E-16	3.44E-06	9.47E-18	3.50E-08	3.15E+07	2.16E-15
BA137M	7.38E+04	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	2.11E-13	3.44E-06	4.63E-14	1.71E-04	3.15E+07	3.92E-09
RH106	1.44E+04	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	4.12E-14	3.44E-06	1.72E-14	6.36E-05	3.15E+07	2.84E-10
CE144	8.14E+03	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	2.33E-14	3.44E-06	2.49E-15	9.21E-06	3.15E+07	2.32E-11
PR144	8.14E+03	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	2.33E-14	3.44E-06	2.99E-15	1.11E-05	3.15E+07	2.79E-11
TE125M	4.86E+02	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.39E-15	3.44E-06	1.22E-15	4.51E-06	3.15E+07	6.80E-13
													Total	9.29E-06

MPC-32														
Normal Conditions														
Effective Dose Equivalent From Submersion														
Nuclide	Inventory (Ci/Assy)	% available for release	% remain airborne	No. Assy	MPC Vol (cm3)	L_{nor} Rate at Upstream (cm3/s)	Fraction Released per sec	Release Fraction	Release Rate (Ci/sec)	X/Q (sec/m3)	DCF (Sv/Bq)	DCF (mRem/uCi)	Occ Time (sec)	DDE (mRem)
									Gases					
H 3	2.97E+02	2.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.30	8.49E-11	3.44E-06	0.00E+00	0.00E+00	3.15E+07	0.00E+00
I129	2.64E-02	2.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.30	7.55E-15	3.44E-06	3.86E-16	1.43E-06	3.15E+07	1.17E-12
KR 85	4.82E+03	2.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.30	1.38E-09	3.44E-06	1.18E-16	4.37E-07	3.15E+07	6.52E-08
									Crud					
CO 60	2.18E+01	100.0%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.15	1.24E-10	3.44E-06	1.27E-13	4.70E-04	3.15E+07	6.34E-06
									Volatiles					
SR 90	5.10E+04	2.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	9.72E-12	3.44E-06	7.33E-18	2.71E-08	3.15E+07	2.86E-11
RU106	1.44E+04	2.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	2.74E-12	3.44E-06	0.00E+00	0.00E+00	3.15E+07	0.00E+00
CS134	3.01E+04	2.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	5.74E-12	3.44E-06	7.57E-14	2.80E-04	3.15E+07	1.74E-07
CS137	7.82E+04	2.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	1.49E-11	3.44E-06	7.55E-18	2.79E-08	3.15E+07	4.51E-11
									Fines					
PU241	7.75E+04	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	2.22E-13	3.44E-06	6.98E-20	2.58E-10	3.15E+07	6.20E-15
Y 90	5.10E+04	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.46E-13	3.44E-06	1.87E-16	6.92E-07	3.15E+07	1.09E-11
PM147	2.57E+04	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	7.35E-14	3.44E-06	6.75E-19	2.50E-09	3.15E+07	1.99E-14
EU154	4.51E+03	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.29E-14	3.44E-06	6.15E-14	2.28E-04	3.15E+07	3.18E-10
CM244	5.57E+03	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.59E-14	3.44E-06	4.19E-18	1.55E-08	3.15E+07	2.67E-14
PU238	3.76E+03	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.07E-14	3.44E-06	4.01E-18	1.48E-08	3.15E+07	1.73E-14
SB125	1.99E+03	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	5.69E-15	3.44E-06	2.01E-14	7.44E-05	3.15E+07	4.58E-11
EU155	1.28E+03	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	3.66E-15	3.44E-06	2.41E-15	8.92E-06	3.15E+07	3.54E-12
AM241	8.06E+02	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	2.30E-15	3.44E-06	7.83E-16	2.90E-06	3.15E+07	7.23E-13
PU240	3.65E+02	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.04E-15	3.44E-06	3.92E-18	1.45E-08	3.15E+07	1.64E-15
PU239	1.99E+02	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	5.69E-16	3.44E-06	3.88E-18	1.44E-08	3.15E+07	8.85E-16
BA137M	7.38E+04	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	2.11E-13	3.44E-06	2.88E-14	1.07E-04	3.15E+07	2.44E-09
RH106	1.44E+04	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	4.12E-14	3.44E-06	1.03E-14	3.81E-05	3.15E+07	1.70E-10
CE144	8.14E+03	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	2.33E-14	3.44E-06	8.33E-16	3.08E-06	3.15E+07	7.77E-12
PR144	8.14E+03	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	2.33E-14	3.44E-06	1.95E-15	7.22E-06	3.15E+07	1.82E-11
TE125M	4.86E+02	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.39E-15	3.44E-06	4.64E-16	1.72E-06	3.15E+07	2.59E-13
													Total	6.58E-06

MPC-32														
Normal Conditions														
Effective Dose Equivalent From Submersion														
Nuclide	Inventory (Ci/Assy)	% available for release	% remain airborne	No. Assy	MPC Vol (cm3)	L_{nor} Rate at Upstream (cm3/s)	Fraction Released per sec	Release Fraction	Release Rate (Ci/sec)	X/Q (sec/m3)	DCF (Sv/Bq)	DCF (mRem/uCi)	Occ Time (sec)	DDE (mRem)
									Gases					
H 3	2.97E+02	2.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.30	8.49E-11	3.44E-06	3.31E-19	1.22E-09	3.15E+07	1.13E-11
I129	2.64E-02	2.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.30	7.55E-15	3.44E-06	3.80E-16	1.41E-06	3.15E+07	1.15E-12
KR 85	4.82E+03	2.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.30	1.38E-09	3.44E-06	1.19E-16	4.40E-07	3.15E+07	6.57E-08
									Crud					
CO 60	2.18E+01	100.0%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.15	1.24E-10	3.44E-06	1.26E-13	4.66E-04	3.15E+07	6.29E-06
									Volatiles					
SR 90	5.10E+04	2.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	9.72E-12	3.44E-06	7.53E-18	2.79E-08	3.15E+07	2.93E-11
RU106	1.44E+04	2.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	2.74E-12	3.44E-06	0.00E+00	0.00E+00	3.15E+07	0.00E+00
CS134	3.01E+04	2.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	5.74E-12	3.44E-06	7.57E-14	2.80E-04	3.15E+07	1.74E-07
CS137	7.82E+04	2.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	1.49E-11	3.44E-06	7.74E-18	2.86E-08	3.15E+07	4.62E-11
									Fines					
PU241	7.75E+04	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	2.22E-13	3.44E-06	7.25E-20	2.68E-10	3.15E+07	6.44E-15
Y 90	5.10E+04	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.46E-13	3.44E-06	1.90E-16	7.03E-07	3.15E+07	1.11E-11
PM147	2.57E+04	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	7.35E-14	3.44E-06	6.93E-19	2.56E-09	3.15E+07	2.04E-14
EU154	4.51E+03	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.29E-14	3.44E-06	6.14E-14	2.27E-04	3.15E+07	3.17E-10
CM244	5.57E+03	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.59E-14	3.44E-06	4.91E-18	1.82E-08	3.15E+07	3.13E-14
PU238	3.76E+03	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.07E-14	3.44E-06	4.88E-18	1.81E-08	3.15E+07	2.10E-14
SB125	1.99E+03	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	5.69E-15	3.44E-06	2.02E-14	7.47E-05	3.15E+07	4.60E-11
EU155	1.28E+03	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	3.66E-15	3.44E-06	2.49E-15	9.21E-06	3.15E+07	3.65E-12
AM241	8.06E+02	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	2.30E-15	3.44E-06	8.18E-16	3.03E-06	3.15E+07	7.56E-13
PU240	3.65E+02	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.04E-15	3.44E-06	4.75E-18	1.76E-08	3.15E+07	1.99E-15
PU239	1.99E+02	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	5.69E-16	3.44E-06	4.24E-18	1.57E-08	3.15E+07	9.67E-16
BA137M	7.38E+04	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	2.11E-13	3.44E-06	2.88E-14	1.07E-04	3.15E+07	2.44E-09
RH106	1.44E+04	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	4.12E-14	3.44E-06	1.04E-14	3.85E-05	3.15E+07	1.72E-10
CE144	8.14E+03	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	2.33E-14	3.44E-06	8.53E-16	3.16E-06	3.15E+07	7.96E-12
PR144	8.14E+03	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	2.33E-14	3.44E-06	1.95E-15	7.22E-06	3.15E+07	1.82E-11
TE125M	4.86E+02	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.39E-15	3.44E-06	4.53E-16	1.68E-06	3.15E+07	2.53E-13
													Total	6.53E-06

Sub-Skin

MPC-32														
Normal Conditions														
Effective Dose Equivalent From Submersion														
Nuclide	Inventory (Ci/Assy)	% available for release	% remain airborne	No. Assy	MPC Vol (cm3)	L_{nor} Rate at Upstream (cm3/s)	Fraction Released per sec	Release Fraction	Release Rate (Ci/sec)	X/Q (sec/m3)	DCF (Sv/Bq)	DCF (mRem/uCi)	Occ Time (sec)	SDE (mRem)
									Gases					
H 3	2.97E+02	2.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.30	8.49E-11	3.44E-06	0.00E+00	0.00E+00	3.15E+07	0.00E+00
I129	2.64E-02	2.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.30	7.55E-15	3.44E-06	1.10E-15	4.07E-06	3.15E+07	3.33E-12
KR 85	4.82E+03	2.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.30	1.38E-09	3.44E-06	1.32E-14	4.88E-05	3.15E+07	7.29E-06
									Crud					
CO 60	2.18E+01	100.0%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.15	1.24E-10	3.44E-06	1.45E-13	5.37E-04	3.15E+07	7.24E-06
									Volatiles					
SR 90	5.10E+04	2.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	9.72E-12	3.44E-06	9.20E-15	3.40E-05	3.15E+07	3.59E-08
RU106	1.44E+04	2.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	2.74E-12	3.44E-06	0.00E+00	0.00E+00	3.15E+07	0.00E+00
CS134	3.01E+04	2.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	5.74E-12	3.44E-06	9.45E-14	3.50E-04	3.15E+07	2.17E-07
CS137	7.82E+04	2.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	1.49E-11	3.44E-06	8.63E-15	3.19E-05	3.15E+07	5.16E-08
									Fines					
PU241	7.75E+04	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	2.22E-13	3.44E-06	1.17E-19	4.33E-10	3.15E+07	1.04E-14
Y 90	5.10E+04	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.46E-13	3.44E-06	6.24E-14	2.31E-04	3.15E+07	3.65E-09
PM147	2.57E+04	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	7.35E-14	3.44E-06	8.11E-16	3.00E-06	3.15E+07	2.39E-11
EU154	4.51E+03	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.29E-14	3.44E-06	8.29E-14	3.07E-04	3.15E+07	4.29E-10
CM244	5.57E+03	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.59E-14	3.44E-06	3.91E-17	1.45E-07	3.15E+07	2.50E-13
PU238	3.76E+03	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.07E-14	3.44E-06	4.09E-17	1.51E-07	3.15E+07	1.76E-13
SB125	1.99E+03	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	5.69E-15	3.44E-06	2.65E-14	9.81E-05	3.15E+07	6.04E-11
EU155	1.28E+03	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	3.66E-15	3.44E-06	3.39E-15	1.25E-05	3.15E+07	4.97E-12
AM241	8.06E+02	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	2.30E-15	3.44E-06	1.28E-15	4.74E-06	3.15E+07	1.18E-12
PU240	3.65E+02	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.04E-15	3.44E-06	3.92E-17	1.45E-07	3.15E+07	1.64E-14
PU239	1.99E+02	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	5.69E-16	3.44E-06	1.86E-17	6.88E-08	3.15E+07	4.24E-15
BA137M	7.38E+04	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	2.11E-13	3.44E-06	3.73E-14	1.38E-04	3.15E+07	3.16E-09
RH106	1.44E+04	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	4.12E-14	3.44E-06	1.09E-13	4.03E-04	3.15E+07	1.80E-09
CE144	8.14E+03	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	2.33E-14	3.44E-06	2.93E-15	1.08E-05	3.15E+07	2.73E-11
PR144	8.14E+03	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	2.33E-14	3.44E-06	8.43E-14	3.12E-04	3.15E+07	7.86E-10
TE125M	4.86E+02	2.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.39E-15	3.44E-06	1.94E-15	7.18E-06	3.15E+07	1.08E-12
													Total	1.48E-05

hing te sec)	DCF (Sv/Bq)	DCF (mRem/uCi)	Occ Time (sec)	CDE (mRem)
-04	1.73E-11	6.40E-02	3.15E+07	8.94E-07
-04	8.69E-11	3.22E-01	3.15E+07	3.99E-10
-04	0.00E+00	0.00E+00	3.15E+07	0.00E+00
-04	4.76E-09	1.76E+01	3.15E+07	7.84E-05
-04	2.64E-09	9.77E+00	3.15E+07	1.56E-05
-04	1.38E-08	5.11E+01	3.15E+07	2.30E-05
-04	1.30E-08	4.81E+01	3.15E+07	4.54E-05
-04	8.76E-09	3.24E+01	3.15E+07	7.94E-05
-04	6.82E-07	2.52E+03	3.15E+07	9.19E-05
-04	9.52E-12	3.52E-02	3.15E+07	8.44E-10
-04	1.88E-14	6.96E-05	3.15E+07	8.40E-13
-04	1.17E-08	4.33E+01	3.15E+07	9.18E-08
-04	1.59E-05	5.88E+04	3.15E+07	1.54E-04
-04	2.80E-05	1.04E+05	3.15E+07	1.83E-04
-04	3.60E-10	1.33E+00	3.15E+07	1.25E-09
-04	3.56E-10	1.32E+00	3.15E+07	7.92E-10
-04	3.25E-05	1.20E+05	3.15E+07	4.56E-05
-04	3.18E-05	1.18E+05	3.15E+07	2.02E-05
-04	3.18E-05	1.18E+05	3.15E+07	1.10E-05
-04	0.00E+00	0.00E+00	3.15E+07	0.00E+00
-04	0.00E+00	0.00E+00	3.15E+07	0.00E+00
-04	1.93E-09	7.14E+00	3.15E+07	2.73E-08
-04	2.41E-15	8.92E-06	3.15E+07	3.41E-14
-04	1.24E-10	4.59E-01	3.15E+07	1.05E-10
			Total	7.49E-04

MPC-32 Off-Normal Conditions Committed Effective Dose Equivalent From Inhalation															
Nuclide	Inventory (Ci/Assy)	% available for release	% remain airborne	No. Assy	MPC Vol (cm3)	L_{nor} Rate at Upstream (cm3/s)	Fraction Released per sec	Release Fraction	Release Rate (Ci/sec)	X/Q (sec/m3)	Breathing Rate (m3/sec)	DCF (Sv/Bq)	DCF (mRem/uCi)	Occ Time (sec)	CDE (mRem)
									Gases						
H 3	2.97E+02	11.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.30	3.90E-10	3.44E-06	3.30E-04	1.73E-11	6.40E-02	3.15E+07	8.94E-07
I129	2.64E-02	11.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.30	3.47E-14	3.44E-06	3.30E-04	2.09E-10	7.73E-01	3.15E+07	9.60E-10
KR 85	4.82E+03	11.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.30	6.34E-09	3.44E-06	3.30E-04	0.00E+00	0.00E+00	3.15E+07	0.00E+00
									Crud						
CO 60	2.18E+01	100.0%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.15	1.24E-10	3.44E-06	3.30E-04	1.84E-08	6.81E+01	3.15E+07	3.03E-04
									Volatiles						
SR 90	5.10E+04	11.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	4.47E-11	3.44E-06	3.30E-04	2.64E-09	9.77E+00	3.15E+07	1.56E-05
RU106	1.44E+04	11.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	1.26E-11	3.44E-06	3.30E-04	1.37E-08	5.07E+01	3.15E+07	2.29E-05
CS134	3.01E+04	11.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	2.64E-11	3.44E-06	3.30E-04	1.08E-08	4.00E+01	3.15E+07	3.77E-05
CS137	7.82E+04	11.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	6.85E-11	3.44E-06	3.30E-04	7.84E-09	2.90E+01	3.15E+07	7.11E-05
									Fines						
PU241	7.75E+04	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.02E-12	3.44E-06	3.30E-04	3.06E-11	1.13E-01	3.15E+07	4.12E-09
Y 90	5.10E+04	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	6.70E-13	3.44E-06	3.30E-04	9.52E-12	3.52E-02	3.15E+07	8.44E-10
PM147	2.57E+04	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	3.38E-13	3.44E-06	3.30E-04	3.60E-14	1.33E-04	3.15E+07	1.61E-12
EU154	4.51E+03	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	5.93E-14	3.44E-06	3.30E-04	1.55E-08	5.74E+01	3.15E+07	1.22E-07
CM244	5.57E+03	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	7.32E-14	3.44E-06	3.30E-04	1.04E-09	3.85E+00	3.15E+07	1.01E-08
PU238	3.76E+03	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	4.94E-14	3.44E-06	3.30E-04	1.00E-09	3.70E+00	3.15E+07	6.54E-09
SB125	1.99E+03	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	2.61E-14	3.44E-06	3.30E-04	4.16E-10	1.54E+00	3.15E+07	1.44E-09
EU155	1.28E+03	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.68E-14	3.44E-06	3.30E-04	6.14E-10	2.27E+00	3.15E+07	1.37E-09
AM241	8.06E+02	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.06E-14	3.44E-06	3.30E-04	2.67E-09	9.88E+00	3.15E+07	3.74E-09
PU240	3.65E+02	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	4.80E-15	3.44E-06	3.30E-04	9.51E-10	3.52E+00	3.15E+07	6.04E-10
PU239	1.99E+02	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	2.62E-15	3.44E-06	3.30E-04	9.22E-10	3.41E+00	3.15E+07	3.19E-10
BA137M	7.38E+04	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	9.70E-13	3.44E-06	3.30E-04	0.00E+00	0.00E+00	3.15E+07	0.00E+00
RH106	1.44E+04	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.89E-13	3.44E-06	3.30E-04	0.00E+00	0.00E+00	3.15E+07	0.00E+00
CE144	8.14E+03	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.07E-13	3.44E-06	3.30E-04	1.97E-09	7.29E+00	3.15E+07	2.79E-08
PR144	8.14E+03	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.07E-13	3.44E-06	3.30E-04	1.05E-14	3.89E-05	3.15E+07	1.49E-13
TE125M	4.86E+02	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	6.39E-15	3.44E-06	3.30E-04	1.07E-10	3.96E-01	3.15E+07	9.05E-11
														Total	4.51E-04

MPC-32															
Off-Normal Conditions															
Committed Effective Dose Equivalent From Inhalation															
Nuclide	Inventory (Ci/Assy)	% available for release	% remain airborne	No. Assy	MPC Vol (cm3)	L_{nor} Rate at Upstream (cm3/s)	Fraction Released per sec	Release Fraction	Release Rate (Ci/sec)	X/Q (sec/m3)	Breathing Rate (m3/sec)	DCF (Sv/Bq)	DCF (mRem/uCi)	Occ Time (sec)	CDE (mRem)
									Gases						
H 3	2.97E+02	11.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.30	3.90E-10	3.44E-06	3.30E-04	1.73E-11	6.40E-02	3.15E+07	8.94E-07
I129	2.64E-02	11.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.30	3.47E-14	3.44E-06	3.30E-04	3.14E-10	1.16E+00	3.15E+07	1.44E-09
KR 85	4.82E+03	11.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.30	6.34E-09	3.44E-06	3.30E-04	0.00E+00	0.00E+00	3.15E+07	0.00E+00
									Crud						
CO 60	2.18E+01	100.0%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.15	1.24E-10	3.44E-06	3.30E-04	3.45E-07	1.28E+03	3.15E+07	5.68E-03
									Volatiles						
SR 90	5.10E+04	11.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	4.47E-11	3.44E-06	3.30E-04	2.86E-06	1.06E+04	3.15E+07	1.69E-02
RU106	1.44E+04	11.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	1.26E-11	3.44E-06	3.30E-04	1.04E-06	3.85E+03	3.15E+07	1.74E-03
CS134	3.01E+04	11.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	2.64E-11	3.44E-06	3.30E-04	1.18E-08	4.37E+01	3.15E+07	4.12E-05
CS137	7.82E+04	11.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	6.85E-11	3.44E-06	3.30E-04	8.82E-09	3.26E+01	3.15E+07	8.00E-05
									Fines						
PU241	7.75E+04	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.02E-12	3.44E-06	3.30E-04	3.18E-06	1.18E+04	3.15E+07	4.29E-04
Y 90	5.10E+04	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	6.70E-13	3.44E-06	3.30E-04	9.31E-09	3.44E+01	3.15E+07	8.26E-07
PM147	2.57E+04	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	3.38E-13	3.44E-06	3.30E-04	7.74E-08	2.86E+02	3.15E+07	3.46E-06
EU154	4.51E+03	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	5.93E-14	3.44E-06	3.30E-04	7.92E-08	2.93E+02	3.15E+07	6.21E-07
CM244	5.57E+03	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	7.32E-14	3.44E-06	3.30E-04	1.93E-05	7.14E+04	3.15E+07	1.87E-04
PU238	3.76E+03	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	4.94E-14	3.44E-06	3.30E-04	3.20E-04	1.18E+06	3.15E+07	2.09E-03
SB125	1.99E+03	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	2.61E-14	3.44E-06	3.30E-04	2.17E-08	8.03E+01	3.15E+07	7.51E-08
EU155	1.28E+03	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.68E-14	3.44E-06	3.30E-04	1.19E-08	4.40E+01	3.15E+07	2.65E-08
AM241	8.06E+02	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.06E-14	3.44E-06	3.30E-04	1.84E-05	6.81E+04	3.15E+07	2.58E-05
PU240	3.65E+02	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	4.80E-15	3.44E-06	3.30E-04	3.23E-04	1.20E+06	3.15E+07	2.05E-04
PU239	1.99E+02	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	2.62E-15	3.44E-06	3.30E-04	1.73E-05	6.40E+04	3.15E+07	5.99E-06
BA137M	7.38E+04	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	9.70E-13	3.44E-06	3.30E-04	0.00E+00	0.00E+00	3.15E+07	0.00E+00
RH106	1.44E+04	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.89E-13	3.44E-06	3.30E-04	0.00E+00	0.00E+00	3.15E+07	0.00E+00
CE144	8.14E+03	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.07E-13	3.44E-06	3.30E-04	7.91E-07	2.93E+03	3.15E+07	1.12E-05
PR144	8.14E+03	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.07E-13	3.44E-06	3.30E-04	9.40E-11	3.48E-01	3.15E+07	1.33E-09
TE125M	4.86E+02	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	6.39E-15	3.44E-06	3.30E-04	1.04E-08	3.85E+01	3.15E+07	8.80E-09
														Total	2.74E-02

MPC-32															
Off-Normal Conditions															
Committed Effective Dose Equivalent From Inhalation															
Nuclide	Inventory (Ci/Assy)	% available for release	% remain airborne	No. Assy	MPC Vol (cm3)	L_{nor} Rate at Upstream (cm3/s)	Fraction Released per sec	Release Fraction	Release Rate (Ci/sec)	X/Q (sec/m3)	Breathing Rate (m3/sec)	DCF (Sv/Bq)	DCF (mRem/uCi)	Occ Time (sec)	CDE (mRem)
									Gases						
H 3	2.97E+02	11.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.30	3.90E-10	3.44E-06	3.30E-04	1.73E-11	6.40E-02	3.15E+07	8.94E-07
I129	2.64E-02	11.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.30	3.47E-14	3.44E-06	3.30E-04	1.40E-10	5.18E-01	3.15E+07	6.43E-10
KR 85	4.82E+03	11.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.30	6.34E-09	3.44E-06	3.30E-04	0.00E+00	0.00E+00	3.15E+07	0.00E+00
									Crud						
CO 60	2.18E+01	100.0%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.15	1.24E-10	3.44E-06	3.30E-04	1.72E-08	6.36E+01	3.15E+07	2.83E-04
									Volatiles						
SR 90	5.10E+04	11.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	4.47E-11	3.44E-06	3.30E-04	3.36E-07	1.24E+03	3.15E+07	1.99E-03
RU106	1.44E+04	11.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	1.26E-11	3.44E-06	3.30E-04	1.37E-08	5.07E+01	3.15E+07	2.29E-05
CS134	3.01E+04	11.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	2.64E-11	3.44E-06	3.30E-04	1.18E-08	4.37E+01	3.15E+07	4.12E-05
CS137	7.82E+04	11.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	6.85E-11	3.44E-06	3.30E-04	8.30E-09	3.07E+01	3.15E+07	7.53E-05
									Fines						
PU241	7.75E+04	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.02E-12	3.44E-06	3.30E-04	3.36E-06	1.24E+04	3.15E+07	4.53E-04
Y 90	5.10E+04	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	6.70E-13	3.44E-06	3.30E-04	2.79E-10	1.03E+00	3.15E+07	2.47E-08
PM147	2.57E+04	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	3.38E-13	3.44E-06	3.30E-04	8.16E-09	3.02E+01	3.15E+07	3.65E-07
EU154	4.51E+03	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	5.93E-14	3.44E-06	3.30E-04	1.06E-07	3.92E+02	3.15E+07	8.31E-07
CM244	5.57E+03	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	7.32E-14	3.44E-06	3.30E-04	9.38E-05	3.47E+05	3.15E+07	9.09E-04
PU238	3.76E+03	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	4.94E-14	3.44E-06	3.30E-04	1.52E-04	5.62E+05	3.15E+07	9.94E-04
SB125	1.99E+03	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	2.61E-14	3.44E-06	3.30E-04	6.49E-10	2.40E+00	3.15E+07	2.24E-09
EU155	1.28E+03	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.68E-14	3.44E-06	3.30E-04	1.43E-08	5.29E+01	3.15E+07	3.18E-08
AM241	8.06E+02	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.06E-14	3.44E-06	3.30E-04	1.74E-04	6.44E+05	3.15E+07	2.44E-04
PU240	3.65E+02	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	4.80E-15	3.44E-06	3.30E-04	1.69E-04	6.25E+05	3.15E+07	1.07E-04
PU239	1.99E+02	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	2.62E-15	3.44E-06	3.30E-04	1.69E-04	6.25E+05	3.15E+07	5.85E-05
BA137M	7.38E+04	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	9.70E-13	3.44E-06	3.30E-04	0.00E+00	0.00E+00	3.15E+07	0.00E+00
RH106	1.44E+04	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.89E-13	3.44E-06	3.30E-04	0.00E+00	0.00E+00	3.15E+07	0.00E+00
CE144	8.14E+03	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.07E-13	3.44E-06	3.30E-04	2.67E-08	9.88E+01	3.15E+07	3.78E-07
PR144	8.14E+03	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.07E-13	3.44E-06	3.30E-04	8.08E-14	2.99E-04	3.15E+07	1.14E-12
TE125M	4.86E+02	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	6.39E-15	3.44E-06	3.30E-04	3.01E-09	1.11E+01	3.15E+07	2.55E-09
														Total	5.18E-03

MPC-32															
Off-Normal Conditions															
Committed Effective Dose Equivalent From Inhalation															
Nuclide	Inventory (Ci/Assy)	% available for release	% remain airborne	No. Assy	MPC Vol (cm3)	L_{nor} Rate at Upstream (cm3/s)	Fraction Released per sec	Release Fraction	Release Rate (Ci/sec)	X/Q (sec/m3)	Breathing Rate (m3/sec)	DCF (Sv/Bq)	DCF (mRem/uCi)	Occ Time (sec)	CDE (mRem)
									Gases						
H 3	2.97E+02	11.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.30	3.90E-10	3.44E-06	3.30E-04	1.73E-11	6.40E-02	3.15E+07	8.94E-07
I129	2.64E-02	11.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.30	3.47E-14	3.44E-06	3.30E-04	1.38E-10	5.11E-01	3.15E+07	6.34E-10
KR 85	4.82E+03	11.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.30	6.34E-09	3.44E-06	3.30E-04	0.00E+00	0.00E+00	3.15E+07	0.00E+00
									Crud						
CO 60	2.18E+01	100.0%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.15	1.24E-10	3.44E-06	3.30E-04	1.35E-08	5.00E+01	3.15E+07	2.22E-04
									Volatiles						
SR 90	5.10E+04	11.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	4.47E-11	3.44E-06	3.30E-04	7.27E-07	2.69E+03	3.15E+07	4.30E-03
RU106	1.44E+04	11.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	1.26E-11	3.44E-06	3.30E-04	1.37E-08	5.07E+01	3.15E+07	2.29E-05
CS134	3.01E+04	11.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	2.64E-11	3.44E-06	3.30E-04	1.10E-08	4.07E+01	3.15E+07	3.84E-05
CS137	7.82E+04	11.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	6.85E-11	3.44E-06	3.30E-04	7.94E-09	2.94E+01	3.15E+07	7.20E-05
									Fines						
PU241	7.75E+04	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.02E-12	3.44E-06	3.30E-04	4.20E-05	1.55E+05	3.15E+07	5.66E-03
Y 90	5.10E+04	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	6.70E-13	3.44E-06	3.30E-04	2.78E-10	1.03E+00	3.15E+07	2.47E-08
PM147	2.57E+04	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	3.38E-13	3.44E-06	3.30E-04	1.02E-07	3.77E+02	3.15E+07	4.56E-06
EU154	4.51E+03	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	5.93E-14	3.44E-06	3.30E-04	5.23E-07	1.94E+03	3.15E+07	4.10E-06
CM244	5.57E+03	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	7.32E-14	3.44E-06	3.30E-04	1.17E-03	4.33E+06	3.15E+07	1.13E-02
PU238	3.76E+03	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	4.94E-14	3.44E-06	3.30E-04	1.90E-03	7.03E+06	3.15E+07	1.24E-02
SB125	1.99E+03	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	2.61E-14	3.44E-06	3.30E-04	2.73E-09	1.01E+01	3.15E+07	9.44E-09
EU155	1.28E+03	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.68E-14	3.44E-06	3.30E-04	1.52E-07	5.62E+02	3.15E+07	3.38E-07
AM241	8.06E+02	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.06E-14	3.44E-06	3.30E-04	2.17E-03	8.03E+06	3.15E+07	3.04E-03
PU240	3.65E+02	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	4.80E-15	3.44E-06	3.30E-04	2.11E-03	7.81E+06	3.15E+07	1.34E-03
PU239	1.99E+02	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	2.62E-15	3.44E-06	3.30E-04	2.11E-03	7.81E+06	3.15E+07	7.30E-04
BA137M	7.38E+04	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	9.70E-13	3.44E-06	3.30E-04	0.00E+00	0.00E+00	3.15E+07	0.00E+00
RH106	1.44E+04	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.89E-13	3.44E-06	3.30E-04	0.00E+00	0.00E+00	3.15E+07	0.00E+00
CE144	8.14E+03	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.07E-13	3.44E-06	3.30E-04	4.54E-08	1.68E+02	3.15E+07	6.43E-07
PR144	8.14E+03	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.07E-13	3.44E-06	3.30E-04	1.35E-13	5.00E-04	3.15E+07	1.91E-12
TE125M	4.86E+02	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	6.39E-15	3.44E-06	3.30E-04	3.21E-08	1.19E+02	3.15E+07	2.72E-08
														Total	3.92E-02

MPC-32															
Off-Normal Conditions															
Committed Effective Dose Equivalent From Inhalation															
Nuclide	Inventory (Ci/Assy)	% available for release	% remain airborne	No. Assy	MPC Vol (cm3)	L_{nor} Rate at Upstream (cm3/s)	Fraction Released per sec	Release Fraction	Release Rate (Ci/sec)	X/Q (sec/m3)	Breathing Rate (m3/sec)	DCF (Sv/Bq)	DCF (mRem/uCi)	Occ Time (sec)	CDE (mRem)
									Gases						
H 3	2.97E+02	11.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.30	3.90E-10	3.44E-06	3.30E-04	1.73E-11	6.40E-02	3.15E+07	8.94E-07
I129	2.64E-02	11.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.30	3.47E-14	3.44E-06	3.30E-04	1.56E-06	5.77E+03	3.15E+07	7.16E-06
KR 85	4.82E+03	11.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.30	6.34E-09	3.44E-06	3.30E-04	0.00E+00	0.00E+00	3.15E+07	0.00E+00
									Crud						
CO 60	2.18E+01	100.0%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.15	1.24E-10	3.44E-06	3.30E-04	1.62E-08	5.99E+01	3.15E+07	2.67E-04
									Volatiles						
SR 90	5.10E+04	11.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	4.47E-11	3.44E-06	3.30E-04	2.64E-09	9.77E+00	3.15E+07	1.56E-05
RU106	1.44E+04	11.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	1.26E-11	3.44E-06	3.30E-04	1.37E-08	5.07E+01	3.15E+07	2.29E-05
CS134	3.01E+04	11.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	2.64E-11	3.44E-06	3.30E-04	1.11E-08	4.11E+01	3.15E+07	3.87E-05
CS137	7.82E+04	11.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	6.85E-11	3.44E-06	3.30E-04	7.93E-09	2.93E+01	3.15E+07	7.19E-05
									Fines						
PU241	7.75E+04	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.02E-12	3.44E-06	3.30E-04	1.24E-11	4.59E-02	3.15E+07	1.67E-09
Y 90	5.10E+04	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	6.70E-13	3.44E-06	3.30E-04	9.52E-12	3.52E-02	3.15E+07	8.44E-10
PM147	2.57E+04	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	3.38E-13	3.44E-06	3.30E-04	1.98E-14	7.33E-05	3.15E+07	8.85E-13
EU154	4.51E+03	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	5.93E-14	3.44E-06	3.30E-04	7.14E-09	2.64E+01	3.15E+07	5.60E-08
CM244	5.57E+03	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	7.32E-14	3.44E-06	3.30E-04	1.01E-09	3.74E+00	3.15E+07	9.78E-09
PU238	3.76E+03	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	4.94E-14	3.44E-06	3.30E-04	9.62E-10	3.56E+00	3.15E+07	6.29E-09
SB125	1.99E+03	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	2.61E-14	3.44E-06	3.30E-04	3.24E-10	1.20E+00	3.15E+07	1.12E-09
EU155	1.28E+03	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.68E-14	3.44E-06	3.30E-04	2.40E-10	8.88E-01	3.15E+07	5.34E-10
AM241	8.06E+02	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.06E-14	3.44E-06	3.30E-04	1.60E-09	5.92E+00	3.15E+07	2.24E-09
PU240	3.65E+02	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	4.80E-15	3.44E-06	3.30E-04	9.05E-10	3.35E+00	3.15E+07	5.74E-10
PU239	1.99E+02	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	2.62E-15	3.44E-06	3.30E-04	9.03E-10	3.34E+00	3.15E+07	3.13E-10
BA137M	7.38E+04	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	9.70E-13	3.44E-06	3.30E-04	0.00E+00	0.00E+00	3.15E+07	0.00E+00
RH106	1.44E+04	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.89E-13	3.44E-06	3.30E-04	0.00E+00	0.00E+00	3.15E+07	0.00E+00
CE144	8.14E+03	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.07E-13	3.44E-06	3.30E-04	1.88E-09	6.96E+00	3.15E+07	2.66E-08
PR144	8.14E+03	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.07E-13	3.44E-06	3.30E-04	8.47E-15	3.13E-05	3.15E+07	1.20E-13
TE125M	4.86E+02	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	6.39E-15	3.44E-06	3.30E-04	9.93E-11	3.67E-01	3.15E+07	8.40E-11
														Total	4.24E-04

MPC-32															
Off-Normal Conditions															
Committed Effective Dose Equivalent From Inhalation															
Nuclide	Inventory (Ci/Assy)	% available for release	% remain airborne	No. Assy	MPC Vol (cm3)	L_{nor} Rate at Upstream (cm3/s)	Fraction Released per sec	Release Fraction	Release Rate (Ci/sec)	X/Q (sec/m3)	Breathing Rate (m3/sec)	DCF (Sv/Bq)	DCF (mRem/uCi)	Occ Time (sec)	CEDE (mRem)
									Gases						
H 3	2.97E+02	11.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.30	3.91E-10	3.44E-06	3.30E-04	1.73E-11	6.40E-02	3.15E+07	8.94E-07
I129	2.64E-02	11.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.30	3.47E-14	3.44E-06	3.30E-04	4.69E-08	1.74E+02	3.15E+07	2.15E-07
KR 85	4.82E+03	11.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.30	6.34E-09	3.44E-06	3.30E-04	0.00E+00	0.00E+00	3.15E+07	0.00E+00
									Crud						
CO 60	2.18E+01	100.0%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.15	1.24E-10	3.44E-06	3.30E-04	5.91E-08	2.19E+02	3.15E+07	9.73E-04
									Volatiles						
SR 90	5.10E+04	11.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	4.47E-11	3.44E-06	3.30E-04	3.51E-07	1.30E+03	3.15E+07	2.08E-03
RU106	1.44E+04	11.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	1.26E-11	3.44E-06	3.30E-04	1.29E-07	4.77E+02	3.15E+07	2.15E-04
CS134	3.01E+04	11.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	2.64E-11	3.44E-06	3.30E-04	1.25E-08	4.63E+01	3.15E+07	4.36E-05
CS137	7.82E+04	11.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	6.86E-11	3.44E-06	3.30E-04	8.63E-09	3.19E+01	3.15E+07	7.83E-05
									Fines						
PU241	7.75E+04	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.02E-12	3.44E-06	3.30E-04	2.23E-06	8.25E+03	3.15E+07	3.01E-04
Y 90	5.10E+04	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	6.71E-13	3.44E-06	3.30E-04	2.28E-09	8.44E+00	3.15E+07	2.02E-07
PM147	2.57E+04	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	3.38E-13	3.44E-06	3.30E-04	1.06E-08	3.92E+01	3.15E+07	4.74E-07
EU154	4.51E+03	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	5.93E-14	3.44E-06	3.30E-04	7.73E-08	2.86E+02	3.15E+07	6.07E-07
CM244	5.57E+03	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	7.32E-14	3.44E-06	3.30E-04	6.70E-05	2.48E+05	3.15E+07	6.49E-04
PU238	3.76E+03	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	4.94E-14	3.44E-06	3.30E-04	1.06E-04	3.92E+05	3.15E+07	6.93E-04
SB125	1.99E+03	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	2.62E-14	3.44E-06	3.30E-04	3.30E-09	1.22E+01	3.15E+07	1.14E-08
EU155	1.28E+03	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.68E-14	3.44E-06	3.30E-04	1.12E-08	4.14E+01	3.15E+07	2.49E-08
AM241	8.06E+02	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.06E-14	3.44E-06	3.30E-04	1.20E-04	4.44E+05	3.15E+07	1.68E-04
PU240	3.65E+02	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	4.80E-15	3.44E-06	3.30E-04	1.16E-04	4.29E+05	3.15E+07	7.37E-05
PU239	1.99E+02	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	2.62E-15	3.44E-06	3.30E-04	1.16E-04	4.29E+05	3.15E+07	4.02E-05
BA137M	7.38E+04	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	9.70E-13	3.44E-06	3.30E-04	0.00E+00	0.00E+00	3.15E+07	0.00E+00
RH106	1.44E+04	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.89E-13	3.44E-06	3.30E-04	0.00E+00	0.00E+00	3.15E+07	0.00E+00
CE144	8.14E+03	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.07E-13	3.44E-06	3.30E-04	5.84E-08	2.16E+02	3.15E+07	8.27E-07
PR144	8.14E+03	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.07E-13	3.44E-06	3.30E-04	1.17E-11	4.33E-02	3.15E+07	1.66E-10
TE125M	4.86E+02	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	6.40E-15	3.44E-06	3.30E-04	1.52E-09	5.62E+00	3.15E+07	1.29E-09
														Total	5.32E-03

MPC-32

Off-Normal Conditions

Effective Dose Equivalent From Submersion

Nuclide	Inventory (Ci/Assy)	% available for release	% remain airborne	No. Assy	MPC Vol (cm3)	L_{nor} Rate at Upstream (cm3/s)	Fraction Released per sec	Release Fraction	Release Rate (Ci/sec)	X/Q (sec/m3)	DCF (Sv/Bq)	DCF (mRem/uCi)	Occ Time (sec)	DDE (mRem)
									Gases					
H 3	2.97E+02	11.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.30	3.90E-10	3.44E-06	0.00E+00	0.00E+00	3.15E+07	0.00E+00
I129	2.64E-02	11.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.30	3.47E-14	3.44E-06	4.83E-16	1.79E-06	3.15E+07	6.72E-12
KR 85	4.82E+03	11.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.30	6.34E-09	3.44E-06	1.17E-16	4.33E-07	3.15E+07	2.97E-07
									Crud					
CO 60	2.18E+01	100.0%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.15	1.24E-10	3.44E-06	1.23E-13	4.55E-04	3.15E+07	6.14E-06
									Volatiles					
SR 90	5.10E+04	11.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	4.47E-11	3.44E-06	7.78E-18	2.88E-08	3.15E+07	1.39E-10
RU106	1.44E+04	11.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	1.26E-11	3.44E-06	0.00E+00	0.00E+00	3.15E+07	0.00E+00
CS134	3.01E+04	11.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	2.64E-11	3.44E-06	7.40E-14	2.74E-04	3.15E+07	7.83E-07
CS137	7.82E+04	11.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	6.85E-11	3.44E-06	7.96E-18	2.95E-08	3.15E+07	2.19E-10
									Fines					
PU241	7.75E+04	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.02E-12	3.44E-06	7.19E-20	2.66E-10	3.15E+07	2.94E-14
Y 90	5.10E+04	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	6.70E-13	3.44E-06	1.89E-16	6.99E-07	3.15E+07	5.08E-11
PM147	2.57E+04	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	3.38E-13	3.44E-06	7.48E-19	2.77E-09	3.15E+07	1.01E-13
EU154	4.51E+03	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	5.93E-14	3.44E-06	6.00E-14	2.22E-04	3.15E+07	1.43E-09
CM244	5.57E+03	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	7.32E-14	3.44E-06	6.90E-18	2.55E-08	3.15E+07	2.03E-13
PU238	3.76E+03	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	4.94E-14	3.44E-06	6.56E-18	2.43E-08	3.15E+07	1.30E-13
SB125	1.99E+03	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	2.61E-14	3.44E-06	1.98E-14	7.33E-05	3.15E+07	2.08E-10
EU155	1.28E+03	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.68E-14	3.44E-06	2.49E-15	9.21E-06	3.15E+07	1.68E-11
AM241	8.06E+02	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.06E-14	3.44E-06	8.58E-16	3.17E-06	3.15E+07	3.64E-12
PU240	3.65E+02	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	4.80E-15	3.44E-06	6.36E-18	2.35E-08	3.15E+07	1.22E-14
PU239	1.99E+02	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	2.62E-15	3.44E-06	4.84E-18	1.79E-08	3.15E+07	5.08E-15
BA137M	7.38E+04	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	9.70E-13	3.44E-06	2.82E-14	1.04E-04	3.15E+07	1.10E-08
RH106	1.44E+04	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.89E-13	3.44E-06	1.01E-14	3.74E-05	3.15E+07	7.66E-10
CE144	8.14E+03	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.07E-13	3.44E-06	8.53E-16	3.16E-06	3.15E+07	3.66E-11
PR144	8.14E+03	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.07E-13	3.44E-06	1.90E-15	7.03E-06	3.15E+07	8.15E-11
TE125M	4.86E+02	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	6.39E-15	3.44E-06	5.96E-16	2.21E-06	3.15E+07	1.53E-12
													Total	7.23E-06

MPC-32														
Off-Normal Conditions														
Effective Dose Equivalent From Submersion														
Nuclide	Inventory (Ci/Assy)	% available for release	% remain airborne	No. Assy	MPC Vol (cm3)	L_{nor} Rate at Upstream (cm3/s)	Fraction Released per sec	Release Fraction	Release Rate (Ci/sec)	X/Q (sec/m3)	DCF (Sv/Bq)	DCF (mRem/uCi)	Occ Time (sec)	DDE (mRem)
									Gases					
H 3	2.97E+02	11.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.30	3.90E-10	3.44E-06	0.00E+00	0.00E+00	3.15E+07	0.00E+00
I129	2.64E-02	11.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.30	3.47E-14	3.44E-06	6.66E-16	2.46E-06	3.15E+07	9.27E-12
KR 85	4.82E+03	11.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.30	6.34E-09	3.44E-06	1.34E-16	4.96E-07	3.15E+07	3.40E-07
									Crud					
CO 60	2.18E+01	100.0%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.15	1.24E-10	3.44E-06	1.39E-13	5.14E-04	3.15E+07	6.93E-06
									Volatiles					
SR 90	5.10E+04	11.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	4.47E-11	3.44E-06	9.49E-18	3.51E-08	3.15E+07	1.70E-10
RU106	1.44E+04	11.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	1.26E-11	3.44E-06	0.00E+00	0.00E+00	3.15E+07	0.00E+00
CS134	3.01E+04	11.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	2.64E-11	3.44E-06	8.43E-14	3.12E-04	3.15E+07	8.91E-07
CS137	7.82E+04	11.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	6.85E-11	3.44E-06	9.67E-18	3.58E-08	3.15E+07	2.66E-10
									Fines					
PU241	7.75E+04	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.02E-12	3.44E-06	8.67E-20	3.21E-10	3.15E+07	3.54E-14
Y 90	5.10E+04	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	6.70E-13	3.44E-06	2.20E-16	8.14E-07	3.15E+07	5.91E-11
PM147	2.57E+04	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	3.38E-13	3.44E-06	9.56E-19	3.54E-09	3.15E+07	1.29E-13
EU154	4.51E+03	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	5.93E-14	3.44E-06	6.81E-14	2.52E-04	3.15E+07	1.62E-09
CM244	5.57E+03	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	7.32E-14	3.44E-06	1.33E-17	4.92E-08	3.15E+07	3.90E-13
PU238	3.76E+03	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	4.94E-14	3.44E-06	1.27E-17	4.70E-08	3.15E+07	2.52E-13
SB125	1.99E+03	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	2.61E-14	3.44E-06	2.27E-14	8.40E-05	3.15E+07	2.38E-10
EU155	1.28E+03	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.68E-14	3.44E-06	2.95E-15	1.09E-05	3.15E+07	1.99E-11
AM241	8.06E+02	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.06E-14	3.44E-06	1.07E-15	3.96E-06	3.15E+07	4.55E-12
PU240	3.65E+02	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	4.80E-15	3.44E-06	1.23E-17	4.55E-08	3.15E+07	2.37E-14
PU239	1.99E+02	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	2.62E-15	3.44E-06	7.55E-18	2.79E-08	3.15E+07	7.92E-15
BA137M	7.38E+04	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	9.70E-13	3.44E-06	3.22E-14	1.19E-04	3.15E+07	1.25E-08
RH106	1.44E+04	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.89E-13	3.44E-06	1.16E-14	4.29E-05	3.15E+07	8.80E-10
CE144	8.14E+03	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.07E-13	3.44E-06	1.01E-15	3.74E-06	3.15E+07	4.33E-11
PR144	8.14E+03	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.07E-13	3.44E-06	2.15E-15	7.96E-06	3.15E+07	9.22E-11
TE125M	4.86E+02	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	6.39E-15	3.44E-06	8.48E-16	3.14E-06	3.15E+07	2.17E-12
													Total	8.18E-06

Sub-Lung

MPC-32														
Off-Normal Conditions														
Effective Dose Equivalent From Submersion														
Nuclide	Inventory (Ci/Assy)	% available for release	% remain airborne	No. Assy	MPC Vol (cm3)	L_{nor} Rate at Upstream (cm3/s)	Fraction Released per sec	Release Fraction	Release Rate (Ci/sec)	X/Q (sec/m3)	DCF (Sv/Bq)	DCF (mRem/uCi)	Occ Time (sec)	DDE (mRem)
									Gases					
H 3	2.97E+02	11.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.30	3.90E-10	3.44E-06	2.75E-18	1.02E-08	3.15E+07	4.30E-10
I129	2.64E-02	11.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.30	3.47E-14	3.44E-06	2.14E-16	7.92E-07	3.15E+07	2.98E-12
KR 85	4.82E+03	11.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.30	6.34E-09	3.44E-06	1.14E-16	4.22E-07	3.15E+07	2.90E-07
									Crud					
CO 60	2.18E+01	100.0%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.15	1.24E-10	3.44E-06	1.24E-13	4.59E-04	3.15E+07	6.19E-06
									Volatiles					
SR 90	5.10E+04	11.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	4.47E-11	3.44E-06	6.44E-18	2.38E-08	3.15E+07	1.15E-10
RU106	1.44E+04	11.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	1.26E-11	3.44E-06	0.00E+00	0.00E+00	3.15E+07	0.00E+00
CS134	3.01E+04	11.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	2.64E-11	3.44E-06	7.37E-14	2.73E-04	3.15E+07	7.79E-07
CS137	7.82E+04	11.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	6.85E-11	3.44E-06	6.68E-18	2.47E-08	3.15E+07	1.84E-10
									Fines					
PU241	7.75E+04	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.02E-12	3.44E-06	6.48E-20	2.40E-10	3.15E+07	2.65E-14
Y 90	5.10E+04	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	6.70E-13	3.44E-06	1.77E-16	6.55E-07	3.15E+07	4.76E-11
PM147	2.57E+04	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	3.38E-13	3.44E-06	5.45E-19	2.02E-09	3.15E+07	7.38E-14
EU154	4.51E+03	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	5.93E-14	3.44E-06	5.99E-14	2.22E-04	3.15E+07	1.42E-09
CM244	5.57E+03	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	7.32E-14	3.44E-06	7.08E-19	2.62E-09	3.15E+07	2.08E-14
PU238	3.76E+03	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	4.94E-14	3.44E-06	1.06E-18	3.92E-09	3.15E+07	2.10E-14
SB125	1.99E+03	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	2.61E-14	3.44E-06	1.95E-14	7.22E-05	3.15E+07	2.04E-10
EU155	1.28E+03	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.68E-14	3.44E-06	2.22E-15	8.21E-06	3.15E+07	1.50E-11
AM241	8.06E+02	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.06E-14	3.44E-06	6.74E-16	2.49E-06	3.15E+07	2.86E-12
PU240	3.65E+02	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	4.80E-15	3.44E-06	1.09E-18	4.03E-09	3.15E+07	2.10E-15
PU239	1.99E+02	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	2.62E-15	3.44E-06	2.65E-18	9.81E-09	3.15E+07	2.78E-15
BA137M	7.38E+04	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	9.70E-13	3.44E-06	2.80E-14	1.04E-04	3.15E+07	1.09E-08
RH106	1.44E+04	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.89E-13	3.44E-06	1.01E-14	3.74E-05	3.15E+07	7.66E-10
CE144	8.14E+03	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.07E-13	3.44E-06	7.69E-16	2.85E-06	3.15E+07	3.30E-11
PR144	8.14E+03	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.07E-13	3.44E-06	1.90E-15	7.03E-06	3.15E+07	8.15E-11
TE125M	4.86E+02	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	6.39E-15	3.44E-06	2.23E-16	8.25E-07	3.15E+07	5.72E-13
													Total	7.27E-06

MPC-32 Off-Normal Conditions Effective Dose Equivalent From Submersion														
Nuclide	Inventory (Ci/Assy)	% available for release	% remain airborne	No. Assy	MPC Vol (cm3)	L_{nor} Rate at Upstream (cm3/s)	Fraction Released per sec	Release Fraction	Release Rate (Ci/sec)	X/Q (sec/m3)	DCF (Sv/Bq)	DCF (mRem/uCi)	Occ Time (sec)	DDE (mRem)
									Gases					
H 3	2.97E+02	11.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.30	3.90E-10	3.44E-06	0.00E+00	0.00E+00	3.15E+07	0.00E+00
I129	2.64E-02	11.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.30	3.47E-14	3.44E-06	1.64E-16	6.07E-07	3.15E+07	2.28E-12
KR 85	4.82E+03	11.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.30	6.34E-09	3.44E-06	1.09E-16	4.03E-07	3.15E+07	2.77E-07
									Crud					
CO 60	2.18E+01	100.0%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.15	1.24E-10	3.44E-06	1.23E-13	4.55E-04	3.15E+07	6.14E-06
									Volatiles					
SR 90	5.10E+04	11.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	4.47E-11	3.44E-06	5.44E-18	2.01E-08	3.15E+07	9.75E-11
RU106	1.44E+04	11.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	1.26E-11	3.44E-06	0.00E+00	0.00E+00	3.15E+07	0.00E+00
CS134	3.01E+04	11.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	2.64E-11	3.44E-06	7.19E-14	2.66E-04	3.15E+07	7.60E-07
CS137	7.82E+04	11.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	6.85E-11	3.44E-06	5.70E-18	2.11E-08	3.15E+07	1.57E-10
									Fines					
PU241	7.75E+04	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.02E-12	3.44E-06	5.63E-20	2.08E-10	3.15E+07	2.30E-14
Y 90	5.10E+04	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	6.70E-13	3.44E-06	1.62E-16	5.99E-07	3.15E+07	4.35E-11
PM147	2.57E+04	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	3.38E-13	3.44E-06	4.46E-19	1.65E-09	3.15E+07	6.04E-14
EU154	4.51E+03	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	5.93E-14	3.44E-06	5.87E-14	2.17E-04	3.15E+07	1.40E-09
CM244	5.57E+03	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	7.32E-14	3.44E-06	1.46E-18	5.40E-09	3.15E+07	4.29E-14
PU238	3.76E+03	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	4.94E-14	3.44E-06	1.68E-18	6.22E-09	3.15E+07	3.33E-14
SB125	1.99E+03	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	2.61E-14	3.44E-06	1.87E-14	6.92E-05	3.15E+07	1.96E-10
EU155	1.28E+03	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.68E-14	3.44E-06	1.85E-15	6.85E-06	3.15E+07	1.25E-11
AM241	8.06E+02	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.06E-14	3.44E-06	5.21E-16	1.93E-06	3.15E+07	2.21E-12
PU240	3.65E+02	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	4.80E-15	3.44E-06	1.65E-18	6.11E-09	3.15E+07	3.17E-15
PU239	1.99E+02	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	2.62E-15	3.44E-06	2.67E-18	9.88E-09	3.15E+07	2.80E-15
BA137M	7.38E+04	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	9.70E-13	3.44E-06	2.73E-14	1.01E-04	3.15E+07	1.06E-08
RH106	1.44E+04	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.89E-13	3.44E-06	9.75E-15	3.61E-05	3.15E+07	7.40E-10
CE144	8.14E+03	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.07E-13	3.44E-06	6.68E-16	2.47E-06	3.15E+07	2.87E-11
PR144	8.14E+03	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.07E-13	3.44E-06	1.87E-15	6.92E-06	3.15E+07	8.02E-11
TE125M	4.86E+02	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	6.39E-15	3.44E-06	1.86E-16	6.88E-07	3.15E+07	4.77E-13
													Total	7.19E-06

MPC-32														
Off-Normal Conditions														
Effective Dose Equivalent From Submersion														
Nuclide	Inventory (Ci/Assy)	% available for release	% remain airborne	No. Assy	MPC Vol (cm3)	L_{nor} Rate at Upstream (cm3/s)	Fraction Released per sec	Release Fraction	Release Rate (Ci/sec)	X/Q (sec/m3)	DCF (Sv/Bq)	DCF (mRem/uCi)	Occ Time (sec)	DDE (mRem)
									Gases					
H 3	2.97E+02	11.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.30	3.90E-10	3.44E-06	0.00E+00	0.00E+00	3.15E+07	0.00E+00
I129	2.64E-02	11.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.30	3.47E-14	3.44E-06	1.10E-15	4.07E-06	3.15E+07	1.53E-11
KR 85	4.82E+03	11.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.30	6.34E-09	3.44E-06	2.20E-16	8.14E-07	3.15E+07	5.59E-07
									Crud					
CO 60	2.18E+01	100.0%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.15	1.24E-10	3.44E-06	1.78E-13	6.59E-04	3.15E+07	8.88E-06
									Volatiles					
SR 90	5.10E+04	11.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	4.47E-11	3.44E-06	2.28E-17	8.44E-08	3.15E+07	4.09E-10
RU106	1.44E+04	11.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	1.26E-11	3.44E-06	0.00E+00	0.00E+00	3.15E+07	0.00E+00
CS134	3.01E+04	11.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	2.64E-11	3.44E-06	1.20E-13	4.44E-04	3.15E+07	1.27E-06
CS137	7.82E+04	11.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	6.85E-11	3.44E-06	2.29E-17	8.47E-08	3.15E+07	6.29E-10
									Fines					
PU241	7.75E+04	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.02E-12	3.44E-06	2.19E-19	8.10E-10	3.15E+07	8.94E-14
Y 90	5.10E+04	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	6.70E-13	3.44E-06	4.44E-16	1.64E-06	3.15E+07	1.19E-10
PM147	2.57E+04	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	3.38E-13	3.44E-06	2.18E-18	8.07E-09	3.15E+07	2.95E-13
EU154	4.51E+03	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	5.93E-14	3.44E-06	9.43E-14	3.49E-04	3.15E+07	2.24E-09
CM244	5.57E+03	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	7.32E-14	3.44E-06	8.82E-18	3.26E-08	3.15E+07	2.59E-13
PU238	3.76E+03	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	4.94E-14	3.44E-06	9.30E-18	3.44E-08	3.15E+07	1.84E-13
SB125	1.99E+03	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	2.61E-14	3.44E-06	3.53E-14	1.31E-04	3.15E+07	3.70E-10
EU155	1.28E+03	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.68E-14	3.44E-06	8.09E-15	2.99E-05	3.15E+07	5.46E-11
AM241	8.06E+02	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.06E-14	3.44E-06	2.87E-15	1.06E-05	3.15E+07	1.22E-11
PU240	3.65E+02	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	4.80E-15	3.44E-06	9.26E-18	3.43E-08	3.15E+07	1.78E-14
PU239	1.99E+02	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	2.62E-15	3.44E-06	9.47E-18	3.50E-08	3.15E+07	9.93E-15
BA137M	7.38E+04	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	9.70E-13	3.44E-06	4.63E-14	1.71E-04	3.15E+07	1.80E-08
RH106	1.44E+04	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.89E-13	3.44E-06	1.72E-14	6.36E-05	3.15E+07	1.31E-09
CE144	8.14E+03	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.07E-13	3.44E-06	2.49E-15	9.21E-06	3.15E+07	1.07E-10
PR144	8.14E+03	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.07E-13	3.44E-06	2.99E-15	1.11E-05	3.15E+07	1.28E-10
TE125M	4.86E+02	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	6.39E-15	3.44E-06	1.22E-15	4.51E-06	3.15E+07	3.13E-12
													Total	1.07E-05

MPC-32														
Off-Normal Conditions														
Effective Dose Equivalent From Submersion														
Nuclide	Inventory (Ci/Assy)	% available for release	% remain airborne	No. Assy	MPC Vol (cm3)	L_{nor} Rate at Upstream (cm3/s)	Fraction Released per sec	Release Fraction	Release Rate (Ci/sec)	X/Q (sec/m3)	DCF (Sv/Bq)	DCF (mRem/uCi)	Occ Time (sec)	DDE (mRem)
									Gases					
H 3	2.97E+02	11.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.30	3.90E-10	3.44E-06	0.00E+00	0.00E+00	3.15E+07	0.00E+00
I129	2.64E-02	11.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.30	3.47E-14	3.44E-06	3.86E-16	1.43E-06	3.15E+07	5.37E-12
KR 85	4.82E+03	11.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.30	6.34E-09	3.44E-06	1.18E-16	4.37E-07	3.15E+07	3.00E-07
									Crud					
CO 60	2.18E+01	100.0%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.15	1.24E-10	3.44E-06	1.27E-13	4.70E-04	3.15E+07	6.34E-06
									Volatiles					
SR 90	5.10E+04	11.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	4.47E-11	3.44E-06	7.33E-18	2.71E-08	3.15E+07	1.31E-10
RU106	1.44E+04	11.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	1.26E-11	3.44E-06	0.00E+00	0.00E+00	3.15E+07	0.00E+00
CS134	3.01E+04	11.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	2.64E-11	3.44E-06	7.57E-14	2.80E-04	3.15E+07	8.01E-07
CS137	7.82E+04	11.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	6.85E-11	3.44E-06	7.55E-18	2.79E-08	3.15E+07	2.07E-10
									Fines					
PU241	7.75E+04	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.02E-12	3.44E-06	6.98E-20	2.58E-10	3.15E+07	2.85E-14
Y 90	5.10E+04	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	6.70E-13	3.44E-06	1.87E-16	6.92E-07	3.15E+07	5.03E-11
PM147	2.57E+04	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	3.38E-13	3.44E-06	6.75E-19	2.50E-09	3.15E+07	9.14E-14
EU154	4.51E+03	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	5.93E-14	3.44E-06	6.15E-14	2.28E-04	3.15E+07	1.46E-09
CM244	5.57E+03	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	7.32E-14	3.44E-06	4.19E-18	1.55E-08	3.15E+07	1.23E-13
PU238	3.76E+03	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	4.94E-14	3.44E-06	4.01E-18	1.48E-08	3.15E+07	7.95E-14
SB125	1.99E+03	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	2.61E-14	3.44E-06	2.01E-14	7.44E-05	3.15E+07	2.11E-10
EU155	1.28E+03	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.68E-14	3.44E-06	2.41E-15	8.92E-06	3.15E+07	1.63E-11
AM241	8.06E+02	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.06E-14	3.44E-06	7.83E-16	2.90E-06	3.15E+07	3.33E-12
PU240	3.65E+02	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	4.80E-15	3.44E-06	3.92E-18	1.45E-08	3.15E+07	7.54E-15
PU239	1.99E+02	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	2.62E-15	3.44E-06	3.88E-18	1.44E-08	3.15E+07	4.07E-15
BA137M	7.38E+04	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	9.70E-13	3.44E-06	2.88E-14	1.07E-04	3.15E+07	1.12E-08
RH106	1.44E+04	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.89E-13	3.44E-06	1.03E-14	3.81E-05	3.15E+07	7.82E-10
CE144	8.14E+03	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.07E-13	3.44E-06	8.33E-16	3.08E-06	3.15E+07	3.57E-11
PR144	8.14E+03	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.07E-13	3.44E-06	1.95E-15	7.22E-06	3.15E+07	8.37E-11
TE125M	4.86E+02	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	6.39E-15	3.44E-06	4.64E-16	1.72E-06	3.15E+07	1.19E-12
													Total	7.45E-06

MPC-32														
Off-Normal Conditions														
Effective Dose Equivalent From Submersion														
Nuclide	Inventory (Ci/Assy)	% available for release	% remain airborne	No. Assy	MPC Vol (cm3)	L_{nor} Rate at Upstream (cm3/s)	Fraction Released per sec	Release Fraction	Release Rate (Ci/sec)	X/Q (sec/m3)	DCF (Sv/Bq)	DCF (mRem/uCi)	Occ Time (sec)	DDE (mRem)
									Gases					
H 3	2.97E+02	11.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.30	3.90E-10	3.44E-06	3.31E-19	1.22E-09	3.15E+07	5.18E-11
I129	2.64E-02	11.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.30	3.47E-14	3.44E-06	3.80E-16	1.41E-06	3.15E+07	5.29E-12
KR 85	4.82E+03	11.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.30	6.34E-09	3.44E-06	1.19E-16	4.40E-07	3.15E+07	3.02E-07
									Crud					
CO 60	2.18E+01	100.0%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.15	1.24E-10	3.44E-06	1.26E-13	4.66E-04	3.15E+07	6.29E-06
									Volatiles					
SR 90	5.10E+04	11.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	4.47E-11	3.44E-06	7.53E-18	2.79E-08	3.15E+07	1.35E-10
RU106	1.44E+04	11.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	1.26E-11	3.44E-06	0.00E+00	0.00E+00	3.15E+07	0.00E+00
CS134	3.01E+04	11.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	2.64E-11	3.44E-06	7.57E-14	2.80E-04	3.15E+07	8.01E-07
CS137	7.82E+04	11.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	6.85E-11	3.44E-06	7.74E-18	2.86E-08	3.15E+07	2.13E-10
									Fines					
PU241	7.75E+04	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.02E-12	3.44E-06	7.25E-20	2.68E-10	3.15E+07	2.96E-14
Y 90	5.10E+04	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	6.70E-13	3.44E-06	1.90E-16	7.03E-07	3.15E+07	5.11E-11
PM147	2.57E+04	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	3.38E-13	3.44E-06	6.93E-19	2.56E-09	3.15E+07	9.39E-14
EU154	4.51E+03	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	5.93E-14	3.44E-06	6.14E-14	2.27E-04	3.15E+07	1.46E-09
CM244	5.57E+03	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	7.32E-14	3.44E-06	4.91E-18	1.82E-08	3.15E+07	1.44E-13
PU238	3.76E+03	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	4.94E-14	3.44E-06	4.88E-18	1.81E-08	3.15E+07	9.67E-14
SB125	1.99E+03	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	2.61E-14	3.44E-06	2.02E-14	7.47E-05	3.15E+07	2.12E-10
EU155	1.28E+03	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.68E-14	3.44E-06	2.49E-15	9.21E-06	3.15E+07	1.68E-11
AM241	8.06E+02	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.06E-14	3.44E-06	8.18E-16	3.03E-06	3.15E+07	3.47E-12
PU240	3.65E+02	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	4.80E-15	3.44E-06	4.75E-18	1.76E-08	3.15E+07	9.14E-15
PU239	1.99E+02	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	2.62E-15	3.44E-06	4.24E-18	1.57E-08	3.15E+07	4.45E-15
BA137M	7.38E+04	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	9.70E-13	3.44E-06	2.88E-14	1.07E-04	3.15E+07	1.12E-08
RH106	1.44E+04	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.89E-13	3.44E-06	1.04E-14	3.85E-05	3.15E+07	7.89E-10
CE144	8.14E+03	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.07E-13	3.44E-06	8.53E-16	3.16E-06	3.15E+07	3.66E-11
PR144	8.14E+03	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.07E-13	3.44E-06	1.95E-15	7.22E-06	3.15E+07	8.37E-11
TE125M	4.86E+02	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	6.39E-15	3.44E-06	4.53E-16	1.68E-06	3.15E+07	1.16E-12
													Total	7.40E-06

Sub-Skin

MPC-32 Off-Normal Conditions Effective Dose Equivalent From Submersion														
Nuclide	Inventory (Ci/Assy)	% available for release	% remain airborne	No. Assy	MPC Vol (cm3)	L_{nor} Rate at Upstream (cm3/s)	Fraction Released per sec	Release Fraction	Release Rate (Ci/sec)	X/Q (sec/m3)	DCF (Sv/Bq)	DCF (mRem/uCi)	Occ Time (sec)	SDE (mRem)
									Gases					
H 3	2.97E+02	11.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.30	3.91E-10	3.44E-06	0.00E+00	0.00E+00	3.15E+07	0.00E+00
I129	2.64E-02	11.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.30	3.47E-14	3.44E-06	1.10E-15	4.07E-06	3.15E+07	1.53E-11
KR 85	4.82E+03	11.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.30	6.34E-09	3.44E-06	1.32E-14	4.88E-05	3.15E+07	3.35E-05
									Crud					
CO 60	2.18E+01	100.0%	100%	32	6.19E+06	7.37E-06	1.19E-12	0.15	1.24E-10	3.44E-06	1.45E-13	5.37E-04	3.15E+07	7.24E-06
									Volatiles					
SR 90	5.10E+04	11.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	4.47E-11	3.44E-06	9.20E-15	3.40E-05	3.15E+07	1.65E-07
RU106	1.44E+04	11.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	1.26E-11	3.44E-06	0.00E+00	0.00E+00	3.15E+07	0.00E+00
CS134	3.01E+04	11.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	2.64E-11	3.44E-06	9.45E-14	3.50E-04	3.15E+07	1.00E-06
CS137	7.82E+04	11.5%	100%	32	6.19E+06	7.37E-06	1.19E-12	2.00E-04	6.86E-11	3.44E-06	8.63E-15	3.19E-05	3.15E+07	2.37E-07
									Fines					
PU241	7.75E+04	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.02E-12	3.44E-06	1.17E-19	4.33E-10	3.15E+07	4.78E-14
Y 90	5.10E+04	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	6.71E-13	3.44E-06	6.24E-14	2.31E-04	3.15E+07	1.68E-08
PM147	2.57E+04	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	3.38E-13	3.44E-06	8.11E-16	3.00E-06	3.15E+07	1.10E-10
EU154	4.51E+03	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	5.93E-14	3.44E-06	8.29E-14	3.07E-04	3.15E+07	1.97E-09
CM244	5.57E+03	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	7.32E-14	3.44E-06	3.91E-17	1.45E-07	3.15E+07	1.15E-12
PU238	3.76E+03	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	4.94E-14	3.44E-06	4.09E-17	1.51E-07	3.15E+07	8.11E-13
SB125	1.99E+03	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	2.62E-14	3.44E-06	2.65E-14	9.81E-05	3.15E+07	2.78E-10
EU155	1.28E+03	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.68E-14	3.44E-06	3.39E-15	1.25E-05	3.15E+07	2.29E-11
AM241	8.06E+02	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.06E-14	3.44E-06	1.28E-15	4.74E-06	3.15E+07	5.44E-12
PU240	3.65E+02	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	4.80E-15	3.44E-06	3.92E-17	1.45E-07	3.15E+07	7.54E-14
PU239	1.99E+02	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	2.62E-15	3.44E-06	1.86E-17	6.88E-08	3.15E+07	1.95E-14
BA137M	7.38E+04	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	9.70E-13	3.44E-06	3.73E-14	1.38E-04	3.15E+07	1.45E-08
RH106	1.44E+04	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.89E-13	3.44E-06	1.09E-13	4.03E-04	3.15E+07	8.28E-09
CE144	8.14E+03	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.07E-13	3.44E-06	2.93E-15	1.08E-05	3.15E+07	1.26E-10
PR144	8.14E+03	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	1.07E-13	3.44E-06	8.43E-14	3.12E-04	3.15E+07	3.62E-09
TE125M	4.86E+02	11.5%	10%	32	6.19E+06	7.37E-06	1.19E-12	3.00E-05	6.40E-15	3.44E-06	1.94E-15	7.18E-06	3.15E+07	4.97E-12
													Total	4.22E-05

MPC-32														
Accident Conditions														
Committed Effective Dose Equivalent From Inhalation														
Nuclide	Inventory (Ci/Assy)	% remain airborne	No. Assy	MPC Vol (cm3)	L_{acc} Rate at Upstream (cm3/s)	Fraction Released per sec	Release Fraction	Release Rate (Ci/sec)	X/Q (sec/m3)	Breathing Rate (m3/sec)	DCF (Sv/Bq)	DCF (mRem/uCi)	Occ Time (sec)	CDE (mRem)
								Gases						
H 3	2.97E+02	100%	32	6.19E+06	1.28E-05	2.07E-12	0.30	5.90E-09	4.50E-04	3.30E-04	1.73E-11	6.40E-02	2.59E+06	3.93E-14
I129	2.64E-02	100%	32	6.19E+06	1.28E-05	2.07E-12	0.30	5.24E-13	4.50E-04	3.30E-04	8.69E-11	3.22E-01	2.59E+06	6.49E-08
KR 85	4.82E+03	100%	32	6.19E+06	1.28E-05	2.07E-12	0.30	9.58E-08	4.50E-04	3.30E-04	0.00E+00	0.00E+00	2.59E+06	0.00E+00
								Crud						
CO 60	2.18E+01	100%	32	6.19E+06	1.28E-05	2.07E-12	1.00	1.44E-09	4.50E-04	3.30E-04	4.76E-09	1.76E+01	2.59E+06	9.77E-03
								Volatiles						
SR 90	5.10E+04	100%	32	6.19E+06	1.28E-05	2.07E-12	2.00E-04	6.75E-10	4.50E-04	3.30E-04	2.64E-09	9.77E+00	2.59E+06	2.54E-03
RU106	1.44E+04	100%	32	6.19E+06	1.28E-05	2.07E-12	2.00E-04	1.91E-10	4.50E-04	3.30E-04	1.38E-08	5.11E+01	2.59E+06	3.75E-03
CS134	3.01E+04	100%	32	6.19E+06	1.28E-05	2.07E-12	2.00E-04	3.99E-10	4.50E-04	3.30E-04	1.30E-08	4.81E+01	2.59E+06	7.38E-03
CS137	7.82E+04	100%	32	6.19E+06	1.28E-05	2.07E-12	2.00E-04	1.04E-09	4.50E-04	3.30E-04	8.76E-09	3.24E+01	2.59E+06	1.29E-02
								Fines						
PU241	7.75E+04	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	1.54E-11	4.50E-04	3.30E-04	6.82E-07	2.52E+03	2.59E+06	1.49E-02
Y 90	5.10E+04	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	1.01E-11	4.50E-04	3.30E-04	9.52E-12	3.52E-02	2.59E+06	1.37E-07
PM147	2.57E+04	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	5.11E-12	4.50E-04	3.30E-04	1.88E-14	6.96E-05	2.59E+06	1.37E-10
EU154	4.51E+03	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	8.96E-13	4.50E-04	3.30E-04	1.17E-08	4.33E+01	2.59E+06	1.49E-05
CM244	5.57E+03	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	1.11E-12	4.50E-04	3.30E-04	1.59E-05	5.88E+04	2.59E+06	2.50E-02
PU238	3.76E+03	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	7.47E-13	4.50E-04	3.30E-04	2.80E-05	1.04E+05	2.59E+06	2.98E-02
SB125	1.99E+03	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	3.95E-13	4.50E-04	3.30E-04	3.60E-10	1.33E+00	2.59E+06	2.02E-07
EU155	1.28E+03	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	2.54E-13	4.50E-04	3.30E-04	3.56E-10	1.32E+00	2.59E+06	1.29E-07
AM241	8.06E+02	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	1.60E-13	4.50E-04	3.30E-04	3.25E-05	1.20E+05	2.59E+06	7.41E-03
PU240	3.65E+02	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	7.25E-14	4.50E-04	3.30E-04	3.18E-05	1.18E+05	2.59E+06	3.28E-03
PU239	1.99E+02	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	3.95E-14	4.50E-04	3.30E-04	3.18E-05	1.18E+05	2.59E+06	1.79E-03
BA137M	7.38E+04	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	1.47E-11	4.50E-04	3.30E-04	0.00E+00	0.00E+00	2.59E+06	0.00E+00
RH106	1.44E+04	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	2.86E-12	4.50E-04	3.30E-04	0.00E+00	0.00E+00	2.59E+06	0.00E+00
CE144	8.14E+03	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	1.62E-12	4.50E-04	3.30E-04	1.93E-09	7.14E+00	2.59E+06	4.44E-06
PR144	8.14E+03	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	1.62E-12	4.50E-04	3.30E-04	2.41E-15	8.92E-06	2.59E+06	5.55E-12
TE125M	4.86E+02	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	9.66E-14	4.50E-04	3.30E-04	1.24E-10	4.59E-01	2.59E+06	1.71E-08
													Total	1.19E-01

MPC-32														
Accident Conditions														
Committed Effective Dose Equivalent From Inhalation														
Nuclide	Inventory (Ci/Assy)	% remain airborne	No. Assy	MPC Vol (cm3)	L_{acc} Rate at Upstream (cm3/s)	Fraction Released per sec	Release Fraction	Release Rate (Ci/sec)	X/Q (sec/m3)	Breathing Rate (m3/sec)	DCF (Sv/Bq)	DCF (mRem/uCi)	Occ Time (sec)	CDE (mRem)
								Gases						
H 3	2.97E+02	100%	32	6.19E+06	1.28E-05	2.07E-12	0.30	5.90E-09	4.50E-04	3.30E-04	1.73E-11	6.40E-02	2.59E+06	1.45E-04
I129	2.64E-02	100%	32	6.19E+06	1.28E-05	2.07E-12	0.30	5.24E-13	4.50E-04	3.30E-04	2.09E-10	7.73E-01	2.59E+06	1.56E-07
KR 85	4.82E+03	100%	32	6.19E+06	1.28E-05	2.07E-12	0.30	9.58E-08	4.50E-04	3.30E-04	0.00E+00	0.00E+00	2.59E+06	0.00E+00
								Crud						
CO 60	2.18E+01	100%	32	6.19E+06	1.28E-05	2.07E-12	1.00	1.44E-09	4.50E-04	3.30E-04	1.84E-08	6.81E+01	2.59E+06	3.77E-02
								Volatiles						
SR 90	5.10E+04	100%	32	6.19E+06	1.28E-05	2.07E-12	2.00E-04	6.75E-10	4.50E-04	3.30E-04	2.64E-09	9.77E+00	2.59E+06	2.54E-03
RU106	1.44E+04	100%	32	6.19E+06	1.28E-05	2.07E-12	2.00E-04	1.91E-10	4.50E-04	3.30E-04	1.37E-08	5.07E+01	2.59E+06	3.72E-03
CS134	3.01E+04	100%	32	6.19E+06	1.28E-05	2.07E-12	2.00E-04	3.99E-10	4.50E-04	3.30E-04	1.08E-08	4.00E+01	2.59E+06	6.13E-03
CS137	7.82E+04	100%	32	6.19E+06	1.28E-05	2.07E-12	2.00E-04	1.04E-09	4.50E-04	3.30E-04	7.84E-09	2.90E+01	2.59E+06	1.16E-02
								Fines						
PU241	7.75E+04	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	1.54E-11	4.50E-04	3.30E-04	3.06E-11	1.13E-01	2.59E+06	6.70E-07
Y 90	5.10E+04	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	1.01E-11	4.50E-04	3.30E-04	9.52E-12	3.52E-02	2.59E+06	1.37E-07
PM147	2.57E+04	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	5.11E-12	4.50E-04	3.30E-04	3.60E-14	1.33E-04	2.59E+06	2.62E-10
EU154	4.51E+03	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	8.96E-13	4.50E-04	3.30E-04	1.55E-08	5.74E+01	2.59E+06	1.98E-05
CM244	5.57E+03	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	1.11E-12	4.50E-04	3.30E-04	1.04E-09	3.85E+00	2.59E+06	1.64E-06
PU238	3.76E+03	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	7.47E-13	4.50E-04	3.30E-04	1.00E-09	3.70E+00	2.59E+06	1.06E-06
SB125	1.99E+03	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	3.95E-13	4.50E-04	3.30E-04	4.16E-10	1.54E+00	2.59E+06	2.34E-07
EU155	1.28E+03	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	2.54E-13	4.50E-04	3.30E-04	6.14E-10	2.27E+00	2.59E+06	2.22E-07
AM241	8.06E+02	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	1.60E-13	4.50E-04	3.30E-04	2.67E-09	9.88E+00	2.59E+06	6.08E-07
PU240	3.65E+02	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	7.25E-14	4.50E-04	3.30E-04	9.51E-10	3.52E+00	2.59E+06	9.81E-08
PU239	1.99E+02	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	3.95E-14	4.50E-04	3.30E-04	9.22E-10	3.41E+00	2.59E+06	5.19E-08
BA137M	7.38E+04	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	1.47E-11	4.50E-04	3.30E-04	0.00E+00	0.00E+00	2.59E+06	0.00E+00
RH106	1.44E+04	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	2.86E-12	4.50E-04	3.30E-04	0.00E+00	0.00E+00	2.59E+06	0.00E+00
CE144	8.14E+03	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	1.62E-12	4.50E-04	3.30E-04	1.97E-09	7.29E+00	2.59E+06	4.53E-06
PR144	8.14E+03	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	1.62E-12	4.50E-04	3.30E-04	1.05E-14	3.89E-05	2.59E+06	2.42E-11
TE125M	4.86E+02	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	9.66E-14	4.50E-04	3.30E-04	1.07E-10	3.96E-01	2.59E+06	1.47E-08
													Total	6.19E-02

MPC-32														
Accident Conditions														
Committed Effective Dose Equivalent From Inhalation														
Nuclide	Inventory (Ci/Assy)	% remain airborne	No. Assy	MPC Vol (cm3)	L_{acc} Rate at Upstream (cm3/s)	Fraction Released per sec	Release Fraction	Release Rate (Ci/sec)	X/Q (sec/m3)	Breathing Rate (m3/sec)	DCF (Sv/Bq)	DCF (mRem/uCi)	Occ Time (sec)	CDE (mRem)
								Gases						
H 3	2.97E+02	100%	32	6.19E+06	1.28E-05	2.07E-12	0.30	5.90E-09	4.50E-04	3.30E-04	1.73E-11	6.40E-02	2.59E+06	1.45E-04
I129	2.64E-02	100%	32	6.19E+06	1.28E-05	2.07E-12	0.30	5.24E-13	4.50E-04	3.30E-04	3.14E-10	1.16E+00	2.59E+06	2.34E-07
KR 85	4.82E+03	100%	32	6.19E+06	1.28E-05	2.07E-12	0.30	9.58E-08	4.50E-04	3.30E-04	0.00E+00	0.00E+00	2.59E+06	0.00E+00
								Crud						
CO 60	2.18E+01	100%	32	6.19E+06	1.28E-05	2.07E-12	1.00	1.44E-09	4.50E-04	3.30E-04	3.45E-07	1.28E+03	2.59E+06	7.08E-01
								Volatiles						
SR 90	5.10E+04	100%	32	6.19E+06	1.28E-05	2.07E-12	2.00E-04	6.75E-10	4.50E-04	3.30E-04	2.86E-06	1.06E+04	2.59E+06	2.75E+00
RU106	1.44E+04	100%	32	6.19E+06	1.28E-05	2.07E-12	2.00E-04	1.91E-10	4.50E-04	3.30E-04	1.04E-06	3.85E+03	2.59E+06	2.82E-01
CS134	3.01E+04	100%	32	6.19E+06	1.28E-05	2.07E-12	2.00E-04	3.99E-10	4.50E-04	3.30E-04	1.18E-08	4.37E+01	2.59E+06	6.69E-03
CS137	7.82E+04	100%	32	6.19E+06	1.28E-05	2.07E-12	2.00E-04	1.04E-09	4.50E-04	3.30E-04	8.82E-09	3.26E+01	2.59E+06	1.30E-02
								Fines						
PU241	7.75E+04	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	1.54E-11	4.50E-04	3.30E-04	3.18E-06	1.18E+04	2.59E+06	6.97E-02
Y 90	5.10E+04	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	1.01E-11	4.50E-04	3.30E-04	9.31E-09	3.44E+01	2.59E+06	1.34E-04
PM147	2.57E+04	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	5.11E-12	4.50E-04	3.30E-04	7.74E-08	2.86E+02	2.59E+06	5.62E-04
EU154	4.51E+03	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	8.96E-13	4.50E-04	3.30E-04	7.92E-08	2.93E+02	2.59E+06	1.01E-04
CM244	5.57E+03	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	1.11E-12	4.50E-04	3.30E-04	1.93E-05	7.14E+04	2.59E+06	3.04E-02
PU238	3.76E+03	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	7.47E-13	4.50E-04	3.30E-04	3.20E-04	1.18E+06	2.59E+06	3.40E-01
SB125	1.99E+03	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	3.95E-13	4.50E-04	3.30E-04	2.17E-08	8.03E+01	2.59E+06	1.22E-05
EU155	1.28E+03	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	2.54E-13	4.50E-04	3.30E-04	1.19E-08	4.40E+01	2.59E+06	4.31E-06
AM241	8.06E+02	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	1.60E-13	4.50E-04	3.30E-04	1.84E-05	6.81E+04	2.59E+06	4.19E-03
PU240	3.65E+02	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	7.25E-14	4.50E-04	3.30E-04	3.23E-04	1.20E+06	2.59E+06	3.33E-02
PU239	1.99E+02	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	3.95E-14	4.50E-04	3.30E-04	1.73E-05	6.40E+04	2.59E+06	9.73E-04
BA137M	7.38E+04	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	1.47E-11	4.50E-04	3.30E-04	0.00E+00	0.00E+00	2.59E+06	0.00E+00
RH106	1.44E+04	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	2.86E-12	4.50E-04	3.30E-04	0.00E+00	0.00E+00	2.59E+06	0.00E+00
CE144	8.14E+03	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	1.62E-12	4.50E-04	3.30E-04	7.91E-07	2.93E+03	2.59E+06	1.82E-03
PR144	8.14E+03	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	1.62E-12	4.50E-04	3.30E-04	9.40E-11	3.48E-01	2.59E+06	2.16E-07
TE125M	4.86E+02	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	9.66E-14	4.50E-04	3.30E-04	1.04E-08	3.85E+01	2.59E+06	1.43E-06
													Total	4.24E+00

MPC-32														
Accident Conditions														
Committed Effective Dose Equivalent From Inhalation														
Nuclide	Inventory (Ci/Assy)	% remain airborne	No. Assy	MPC Vol (cm3)	L_{acc} Rate at Upstream (cm3/s)	Fraction Released per sec	Release Fraction	Release Rate (Ci/sec)	X/Q (sec/m3)	Breathing Rate (m3/sec)	DCF (Sv/Bq)	DCF (mRem/uCi)	Occ Time (sec)	CDE (mRem)
								Gases						
H 3	2.97E+02	100%	32	6.19E+06	1.28E-05	2.07E-12	0.30	5.90E-09	4.50E-04	3.30E-04	1.73E-11	6.40E-02	2.59E+06	1.45E-04
I129	2.64E-02	100%	32	6.19E+06	1.28E-05	2.07E-12	0.30	5.24E-13	4.50E-04	3.30E-04	1.40E-10	5.18E-01	2.59E+06	1.04E-07
KR 85	4.82E+03	100%	32	6.19E+06	1.28E-05	2.07E-12	0.30	9.58E-08	4.50E-04	3.30E-04	0.00E+00	0.00E+00	2.59E+06	0.00E+00
								Crud						
CO 60	2.18E+01	100%	32	6.19E+06	1.28E-05	2.07E-12	1.00	1.44E-09	4.50E-04	3.30E-04	1.72E-08	6.36E+01	2.59E+06	3.53E-02
								Volatiles						
SR 90	5.10E+04	100%	32	6.19E+06	1.28E-05	2.07E-12	2.00E-04	6.75E-10	4.50E-04	3.30E-04	3.36E-07	1.24E+03	2.59E+06	3.23E-01
RU106	1.44E+04	100%	32	6.19E+06	1.28E-05	2.07E-12	2.00E-04	1.91E-10	4.50E-04	3.30E-04	1.37E-08	5.07E+01	2.59E+06	3.72E-03
CS134	3.01E+04	100%	32	6.19E+06	1.28E-05	2.07E-12	2.00E-04	3.99E-10	4.50E-04	3.30E-04	1.18E-08	4.37E+01	2.59E+06	6.69E-03
CS137	7.82E+04	100%	32	6.19E+06	1.28E-05	2.07E-12	2.00E-04	1.04E-09	4.50E-04	3.30E-04	8.30E-09	3.07E+01	2.59E+06	1.22E-02
								Fines						
PU241	7.75E+04	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	1.54E-11	4.50E-04	3.30E-04	3.36E-06	1.24E+04	2.59E+06	7.36E-02
Y 90	5.10E+04	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	1.01E-11	4.50E-04	3.30E-04	2.79E-10	1.03E+00	2.59E+06	4.02E-06
PM147	2.57E+04	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	5.11E-12	4.50E-04	3.30E-04	8.16E-09	3.02E+01	2.59E+06	5.93E-05
EU154	4.51E+03	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	8.96E-13	4.50E-04	3.30E-04	1.06E-07	3.92E+02	2.59E+06	1.35E-04
CM244	5.57E+03	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	1.11E-12	4.50E-04	3.30E-04	9.38E-05	3.47E+05	2.59E+06	1.48E-01
PU238	3.76E+03	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	7.47E-13	4.50E-04	3.30E-04	1.52E-04	5.62E+05	2.59E+06	1.62E-01
SB125	1.99E+03	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	3.95E-13	4.50E-04	3.30E-04	6.49E-10	2.40E+00	2.59E+06	3.65E-07
EU155	1.28E+03	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	2.54E-13	4.50E-04	3.30E-04	1.43E-08	5.29E+01	2.59E+06	5.17E-06
AM241	8.06E+02	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	1.60E-13	4.50E-04	3.30E-04	1.74E-04	6.44E+05	2.59E+06	3.96E-02
PU240	3.65E+02	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	7.25E-14	4.50E-04	3.30E-04	1.69E-04	6.25E+05	2.59E+06	1.74E-02
PU239	1.99E+02	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	3.95E-14	4.50E-04	3.30E-04	1.69E-04	6.25E+05	2.59E+06	9.51E-03
BA137M	7.38E+04	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	1.47E-11	4.50E-04	3.30E-04	0.00E+00	0.00E+00	2.59E+06	0.00E+00
RH106	1.44E+04	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	2.86E-12	4.50E-04	3.30E-04	0.00E+00	0.00E+00	2.59E+06	0.00E+00
CE144	8.14E+03	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	1.62E-12	4.50E-04	3.30E-04	2.67E-08	9.88E+01	2.59E+06	6.14E-05
PR144	8.14E+03	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	1.62E-12	4.50E-04	3.30E-04	8.08E-14	2.99E-04	2.59E+06	1.86E-10
TE125M	4.86E+02	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	9.66E-14	4.50E-04	3.30E-04	3.01E-09	1.11E+01	2.59E+06	4.14E-07
													Total	8.31E-01

MPC-32														
Accident Conditions														
Committed Effective Dose Equivalent From Inhalation														
Nuclide	Inventory (Ci/Assy)	% remain airborne	No. Assy	MPC Vol (cm3)	L_{acc} Rate at Upstream (cm3/s)	Fraction Released per sec	Release Fraction	Release Rate (Ci/sec)	X/Q (sec/m3)	Breathing Rate (m3/sec)	DCF (Sv/Bq)	DCF (mRem/uCi)	Occ Time (sec)	CDE (mRem)
								Gases						
H 3	2.97E+02	100%	32	6.19E+06	1.28E-05	2.07E-12	0.30	5.90E-09	4.50E-04	3.30E-04	1.73E-11	6.40E-02	2.59E+06	1.45E-04
I129	2.64E-02	100%	32	6.19E+06	1.28E-05	2.07E-12	0.30	5.24E-13	4.50E-04	3.30E-04	1.38E-10	5.11E-01	2.59E+06	1.03E-07
KR 85	4.82E+03	100%	32	6.19E+06	1.28E-05	2.07E-12	0.30	9.58E-08	4.50E-04	3.30E-04	0.00E+00	0.00E+00	2.59E+06	0.00E+00
								Crud						
CO 60	2.18E+01	100%	32	6.19E+06	1.28E-05	2.07E-12	1.00	1.44E-09	4.50E-04	3.30E-04	1.35E-08	5.00E+01	2.59E+06	2.77E-02
								Volatiles						
SR 90	5.10E+04	100%	32	6.19E+06	1.28E-05	2.07E-12	2.00E-04	6.75E-10	4.50E-04	3.30E-04	7.27E-07	2.69E+03	2.59E+06	6.99E-01
RU106	1.44E+04	100%	32	6.19E+06	1.28E-05	2.07E-12	2.00E-04	1.91E-10	4.50E-04	3.30E-04	1.37E-08	5.07E+01	2.59E+06	3.72E-03
CS134	3.01E+04	100%	32	6.19E+06	1.28E-05	2.07E-12	2.00E-04	3.99E-10	4.50E-04	3.30E-04	1.10E-08	4.07E+01	2.59E+06	6.24E-03
CS137	7.82E+04	100%	32	6.19E+06	1.28E-05	2.07E-12	2.00E-04	1.04E-09	4.50E-04	3.30E-04	7.94E-09	2.94E+01	2.59E+06	1.17E-02
								Fines						
PU241	7.75E+04	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	1.54E-11	4.50E-04	3.30E-04	4.20E-05	1.55E+05	2.59E+06	9.20E-01
Y 90	5.10E+04	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	1.01E-11	4.50E-04	3.30E-04	2.78E-10	1.03E+00	2.59E+06	4.01E-06
PM147	2.57E+04	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	5.11E-12	4.50E-04	3.30E-04	1.02E-07	3.77E+02	2.59E+06	7.41E-04
EU154	4.51E+03	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	8.96E-13	4.50E-04	3.30E-04	5.23E-07	1.94E+03	2.59E+06	6.67E-04
CM244	5.57E+03	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	1.11E-12	4.50E-04	3.30E-04	1.17E-03	4.33E+06	2.59E+06	1.84E+00
PU238	3.76E+03	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	7.47E-13	4.50E-04	3.30E-04	1.90E-03	7.03E+06	2.59E+06	2.02E+00
SB125	1.99E+03	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	3.95E-13	4.50E-04	3.30E-04	2.73E-09	1.01E+01	2.59E+06	1.54E-06
EU155	1.28E+03	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	2.54E-13	4.50E-04	3.30E-04	1.52E-07	5.62E+02	2.59E+06	5.50E-05
AM241	8.06E+02	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	1.60E-13	4.50E-04	3.30E-04	2.17E-03	8.03E+06	2.59E+06	4.94E-01
PU240	3.65E+02	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	7.25E-14	4.50E-04	3.30E-04	2.11E-03	7.81E+06	2.59E+06	2.18E-01
PU239	1.99E+02	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	3.95E-14	4.50E-04	3.30E-04	2.11E-03	7.81E+06	2.59E+06	1.19E-01
BA137M	7.38E+04	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	1.47E-11	4.50E-04	3.30E-04	0.00E+00	0.00E+00	2.59E+06	0.00E+00
RH106	1.44E+04	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	2.86E-12	4.50E-04	3.30E-04	0.00E+00	0.00E+00	2.59E+06	0.00E+00
CE144	8.14E+03	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	1.62E-12	4.50E-04	3.30E-04	4.54E-08	1.68E+02	2.59E+06	1.04E-04
PR144	8.14E+03	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	1.62E-12	4.50E-04	3.30E-04	1.35E-13	5.00E-04	2.59E+06	3.11E-10
TE125M	4.86E+02	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	9.66E-14	4.50E-04	3.30E-04	3.21E-08	1.19E+02	2.59E+06	4.41E-06
													Total	6.36E+00

MPC-32 Accident Conditions Committed Effective Dose Equivalent From Inhalation														
Nuclide	Inventory (Ci/Assy)	% remain airborne	No. Assy	MPC Vol (cm3)	L_{acc} Rate at Upstream (cm3/s)	Fraction Released per sec	Release Fraction	Release Rate (Ci/sec)	X/Q (sec/m3)	Breathing Rate (m3/sec)	DCF (Sv/Bq)	DCF (mRem/uCi)	Occ Time (sec)	CDE (mRem)
								Gases						
H 3	2.97E+02	100%	32	6.19E+06	1.28E-05	2.07E-12	0.30	5.90E-09	4.50E-04	3.30E-04	1.73E-11	6.40E-02	2.59E+06	1.45E-04
I129	2.64E-02	100%	32	6.19E+06	1.28E-05	2.07E-12	0.30	5.24E-13	4.50E-04	3.30E-04	1.56E-06	5.77E+03	2.59E+06	1.16E-03
KR 85	4.82E+03	100%	32	6.19E+06	1.28E-05	2.07E-12	0.30	9.58E-08	4.50E-04	3.30E-04	0.00E+00	0.00E+00	2.59E+06	0.00E+00
								Crud						
CO 60	2.18E+01	100%	32	6.19E+06	1.28E-05	2.07E-12	1.00	1.44E-09	4.50E-04	3.30E-04	1.62E-08	5.99E+01	2.59E+06	3.32E-02
								Volatiles						
SR 90	5.10E+04	100%	32	6.19E+06	1.28E-05	2.07E-12	2.00E-04	6.75E-10	4.50E-04	3.30E-04	2.64E-09	9.77E+00	2.59E+06	2.54E-03
RU106	1.44E+04	100%	32	6.19E+06	1.28E-05	2.07E-12	2.00E-04	1.91E-10	4.50E-04	3.30E-04	1.37E-08	5.07E+01	2.59E+06	3.72E-03
CS134	3.01E+04	100%	32	6.19E+06	1.28E-05	2.07E-12	2.00E-04	3.99E-10	4.50E-04	3.30E-04	1.11E-08	4.11E+01	2.59E+06	6.30E-03
CS137	7.82E+04	100%	32	6.19E+06	1.28E-05	2.07E-12	2.00E-04	1.04E-09	4.50E-04	3.30E-04	7.93E-09	2.93E+01	2.59E+06	1.17E-02
								Fines						
PU241	7.75E+04	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	1.54E-11	4.50E-04	3.30E-04	1.24E-11	4.59E-02	2.59E+06	2.72E-07
Y 90	5.10E+04	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	1.01E-11	4.50E-04	3.30E-04	9.52E-12	3.52E-02	2.59E+06	1.37E-07
PM147	2.57E+04	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	5.11E-12	4.50E-04	3.30E-04	1.98E-14	7.33E-05	2.59E+06	1.44E-10
EU154	4.51E+03	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	8.96E-13	4.50E-04	3.30E-04	7.14E-09	2.64E+01	2.59E+06	9.10E-06
CM244	5.57E+03	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	1.11E-12	4.50E-04	3.30E-04	1.01E-09	3.74E+00	2.59E+06	1.59E-06
PU238	3.76E+03	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	7.47E-13	4.50E-04	3.30E-04	9.62E-10	3.56E+00	2.59E+06	1.02E-06
SB125	1.99E+03	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	3.95E-13	4.50E-04	3.30E-04	3.24E-10	1.20E+00	2.59E+06	1.82E-07
EU155	1.28E+03	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	2.54E-13	4.50E-04	3.30E-04	2.40E-10	8.88E-01	2.59E+06	8.69E-08
AM241	8.06E+02	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	1.60E-13	4.50E-04	3.30E-04	1.60E-09	5.92E+00	2.59E+06	3.65E-07
PU240	3.65E+02	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	7.25E-14	4.50E-04	3.30E-04	9.05E-10	3.35E+00	2.59E+06	9.34E-08
PU239	1.99E+02	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	3.95E-14	4.50E-04	3.30E-04	9.03E-10	3.34E+00	2.59E+06	5.08E-08
BA137M	7.38E+04	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	1.47E-11	4.50E-04	3.30E-04	0.00E+00	0.00E+00	2.59E+06	0.00E+00
RH106	1.44E+04	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	2.86E-12	4.50E-04	3.30E-04	0.00E+00	0.00E+00	2.59E+06	0.00E+00
CE144	8.14E+03	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	1.62E-12	4.50E-04	3.30E-04	1.88E-09	6.96E+00	2.59E+06	4.33E-06
PR144	8.14E+03	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	1.62E-12	4.50E-04	3.30E-04	8.47E-15	3.13E-05	2.59E+06	1.95E-11
TE125M	4.86E+02	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	9.66E-14	4.50E-04	3.30E-04	9.93E-11	3.67E-01	2.59E+06	1.37E-08
													Total	5.88E-02

Nuclide	Inventory (Ci/Assy)	% remain airborne	No. Assy	MPC Vol (cm3)	L_{acc} Rate at Upstream (cm3/s)	Fraction Released per sec	Release Fraction	Release Rate (Ci/sec)	X/Q (sec/m3)	Breathing Rate (m3/sec)	DCF (Sv/Bq)	DCF (mRem/uCi)	Occ Time (sec)	CEDE (mRem)
MPC-32														
Accident Conditions														
Committed Effective Dose Equivalent From Inhalation														
								Gases						
H 3	2.97E+02	100%	32	6.19E+06	1.28E-05	2.07E-12	0.30	5.90E-09	4.50E-04	3.30E-04	1.73E-11	6.40E-02	2.59E+06	1.45E-04
I129	2.64E-02	100%	32	6.19E+06	1.28E-05	2.07E-12	0.30	5.24E-13	4.50E-04	3.30E-04	4.69E-08	1.74E+02	2.59E+06	3.50E-05
KR 85	4.82E+03	100%	32	6.19E+06	1.28E-05	2.07E-12	0.30	9.58E-08	4.50E-04	3.30E-04	0.00E+00	0.00E+00	2.59E+06	0.00E+00
								Crud						
CO 60	2.18E+01	100%	32	6.19E+06	1.28E-05	2.07E-12	1.00	1.44E-09	4.50E-04	3.30E-04	5.91E-08	2.19E+02	2.59E+06	1.21E-01
								Volatiles						
SR 90	5.10E+04	100%	32	6.19E+06	1.28E-05	2.07E-12	2.00E-04	6.75E-10	4.50E-04	3.30E-04	3.51E-07	1.30E+03	2.59E+06	3.37E-01
RU106	1.44E+04	100%	32	6.19E+06	1.28E-05	2.07E-12	2.00E-04	1.91E-10	4.50E-04	3.30E-04	1.29E-07	4.77E+02	2.59E+06	3.50E-02
CS134	3.01E+04	100%	32	6.19E+06	1.28E-05	2.07E-12	2.00E-04	3.99E-10	4.50E-04	3.30E-04	1.25E-08	4.63E+01	2.59E+06	7.09E-03
CS137	7.82E+04	100%	32	6.19E+06	1.28E-05	2.07E-12	2.00E-04	1.04E-09	4.50E-04	3.30E-04	8.63E-09	3.19E+01	2.59E+06	1.27E-02
								Fines						
PU241	7.75E+04	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	1.54E-11	4.50E-04	3.30E-04	2.23E-06	8.25E+03	2.59E+06	4.89E-02
Y 90	5.10E+04	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	1.01E-11	4.50E-04	3.30E-04	2.28E-09	8.44E+00	2.59E+06	3.29E-05
PM147	2.57E+04	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	5.11E-12	4.50E-04	3.30E-04	1.06E-08	3.92E+01	2.59E+06	7.70E-05
EU154	4.51E+03	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	8.96E-13	4.50E-04	3.30E-04	7.73E-08	2.86E+02	2.59E+06	9.86E-05
CM244	5.57E+03	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	1.11E-12	4.50E-04	3.30E-04	6.70E-05	2.48E+05	2.59E+06	1.06E-01
PU238	3.76E+03	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	7.47E-13	4.50E-04	3.30E-04	1.06E-04	3.92E+05	2.59E+06	1.13E-01
SB125	1.99E+03	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	3.95E-13	4.50E-04	3.30E-04	3.30E-09	1.22E+01	2.59E+06	1.86E-06
EU155	1.28E+03	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	2.54E-13	4.50E-04	3.30E-04	1.12E-08	4.14E+01	2.59E+06	4.05E-06
AM241	8.06E+02	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	1.60E-13	4.50E-04	3.30E-04	1.20E-04	4.44E+05	2.59E+06	2.73E-02
PU240	3.65E+02	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	7.25E-14	4.50E-04	3.30E-04	1.16E-04	4.29E+05	2.59E+06	1.20E-02
PU239	1.99E+02	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	3.95E-14	4.50E-04	3.30E-04	1.16E-04	4.29E+05	2.59E+06	6.53E-03
BA137M	7.38E+04	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	1.47E-11	4.50E-04	3.30E-04	0.00E+00	0.00E+00	2.59E+06	0.00E+00
RH106	1.44E+04	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	2.86E-12	4.50E-04	3.30E-04	0.00E+00	0.00E+00	2.59E+06	0.00E+00
CE144	8.14E+03	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	1.62E-12	4.50E-04	3.30E-04	5.84E-08	2.16E+02	2.59E+06	1.34E-04
PR144	8.14E+03	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	1.62E-12	4.50E-04	3.30E-04	1.17E-11	4.33E-02	2.59E+06	2.69E-08
TE125M	4.86E+02	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	9.66E-14	4.50E-04	3.30E-04	1.52E-09	5.62E+00	2.59E+06	2.09E-07
													Total	8.27E-01

MPC-32													
Accident Conditions													
Effective Dose Equivalent From Submersion													
Nuclide	Inventory (Ci/Assy)	% remain airborne	No. Assy	MPC Vol (cm3)	L_{acc} Rate at Upstream (cm3/s)	Fraction Released per sec	Release Fraction	Release Rate (Ci/sec)	X/Q (sec/m3)	DCF (Sv/Bq)	DCF (mRem/uCi)	Occ Time (sec)	DDE (mRem)
								Gases					
H 3	2.97E+02	100%	32	6.19E+06	1.28E-05	2.07E-12	0.30	5.90E-09	4.50E-04	0.00E+00	0.00E+00	2.59E+06	0.00E+00
I129	2.64E-02	100%	32	6.19E+06	1.28E-05	2.07E-12	0.30	5.24E-13	4.50E-04	4.83E-16	1.79E-06	2.59E+06	1.09E-09
KR 85	4.82E+03	100%	32	6.19E+06	1.28E-05	2.07E-12	0.30	9.57E-08	4.50E-04	1.17E-16	4.33E-07	2.59E+06	4.83E-05
								Crud					
CO 60	2.18E+01	100%	32	6.19E+06	1.28E-05	2.07E-12	1.00	1.44E-09	4.50E-04	1.23E-13	4.55E-04	2.59E+06	7.64E-04
								Volatiles					
SR 90	5.10E+04	100%	32	6.19E+06	1.28E-05	2.07E-12	2.00E-04	6.75E-10	4.50E-04	7.78E-18	2.88E-08	2.59E+06	2.26E-08
RU106	1.44E+04	100%	32	6.19E+06	1.28E-05	2.07E-12	2.00E-04	1.91E-10	4.50E-04	0.00E+00	0.00E+00	2.59E+06	0.00E+00
CS134	3.01E+04	100%	32	6.19E+06	1.28E-05	2.07E-12	2.00E-04	3.98E-10	4.50E-04	7.40E-14	2.74E-04	2.59E+06	1.27E-04
CS137	7.82E+04	100%	32	6.19E+06	1.28E-05	2.07E-12	2.00E-04	1.03E-09	4.50E-04	7.96E-18	2.95E-08	2.59E+06	3.55E-08
								Fines					
PU241	7.75E+04	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	1.54E-11	4.50E-04	7.19E-20	2.66E-10	2.59E+06	4.77E-12
Y 90	5.10E+04	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	1.01E-11	4.50E-04	1.89E-16	6.99E-07	2.59E+06	8.25E-09
PM147	2.57E+04	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	5.10E-12	4.50E-04	7.48E-19	2.77E-09	2.59E+06	1.65E-11
EU154	4.51E+03	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	8.95E-13	4.50E-04	6.00E-14	2.22E-04	2.59E+06	2.32E-07
CM244	5.57E+03	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	1.11E-12	4.50E-04	6.90E-18	2.55E-08	2.59E+06	3.29E-11
PU238	3.76E+03	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	7.46E-13	4.50E-04	6.56E-18	2.43E-08	2.59E+06	2.11E-11
SB125	1.99E+03	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	3.95E-13	4.50E-04	1.98E-14	7.33E-05	2.59E+06	3.37E-08
EU155	1.28E+03	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	2.54E-13	4.50E-04	2.49E-15	9.21E-06	2.59E+06	2.73E-09
AM241	8.06E+02	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	1.60E-13	4.50E-04	8.58E-16	3.17E-06	2.59E+06	5.92E-10
PU240	3.65E+02	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	7.25E-14	4.50E-04	6.36E-18	2.35E-08	2.59E+06	1.99E-12
PU239	1.99E+02	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	3.95E-14	4.50E-04	4.84E-18	1.79E-08	2.59E+06	8.25E-13
BA137M	7.38E+04	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	1.47E-11	4.50E-04	2.82E-14	1.04E-04	2.59E+06	1.78E-06
RH106	1.44E+04	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	2.86E-12	4.50E-04	1.01E-14	3.74E-05	2.59E+06	1.25E-07
CE144	8.14E+03	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	1.62E-12	4.50E-04	8.53E-16	3.16E-06	2.59E+06	5.94E-09
PR144	8.14E+03	10%	32	6.19E+06	1.28E-05	2.07E-12	1.00E+00	5.39E-08	4.50E-04	1.90E-15	7.03E-06	2.59E+06	4.41E-04
TE125M	4.86E+02	10%	32	6.19E+06	1.28E-05	2.07E-12	2.00E+00	6.44E-09	4.50E-04	5.96E-16	2.21E-06	2.59E+06	1.65E-05
												Total	1.40E-03

Sub-breast

MPC-32													
Accident Conditions													
Effective Dose Equivalent From Submersion													
Nuclide	Inventory (Ci/Assy)	% remain airborne	No. Assy	MPC Vol (cm3)	L_{acc} Rate at Upstream (cm3/s)	Fraction Released per sec	Release Fraction	Release Rate (Ci/sec)	X/Q (sec/m3)	DCF (Sv/Bq)	DCF (mRem/uCi)	Occ Time (sec)	DDE (mRem)
								Gases					
H 3	2.97E+02	100%	32	6.19E+06	1.28E-05	2.07E-12	0.30	5.90E-09	4.50E-04	0.00E+00	0.00E+00	2.59E+06	0.00E+00
I129	2.64E-02	100%	32	6.19E+06	1.28E-05	2.07E-12	0.30	5.24E-13	4.50E-04	6.66E-16	2.46E-06	2.59E+06	1.51E-09
KR 85	4.82E+03	100%	32	6.19E+06	1.28E-05	2.07E-12	0.30	9.57E-08	4.50E-04	1.34E-16	4.96E-07	2.59E+06	5.53E-05
								Crud					
CO 60	2.18E+01	100%	32	6.19E+06	1.28E-05	2.07E-12	1.00	1.44E-09	4.50E-04	1.39E-13	5.14E-04	2.59E+06	8.63E-04
								Volatiles					
SR 90	5.10E+04	100%	32	6.19E+06	1.28E-05	2.07E-12	2.00E-04	6.75E-10	4.50E-04	9.49E-18	3.51E-08	2.59E+06	2.76E-08
RU106	1.44E+04	100%	32	6.19E+06	1.28E-05	2.07E-12	2.00E-04	1.91E-10	4.50E-04	0.00E+00	0.00E+00	2.59E+06	0.00E+00
CS134	3.01E+04	100%	32	6.19E+06	1.28E-05	2.07E-12	2.00E-04	3.98E-10	4.50E-04	8.43E-14	3.12E-04	2.59E+06	1.45E-04
CS137	7.82E+04	100%	32	6.19E+06	1.28E-05	2.07E-12	2.00E-04	1.03E-09	4.50E-04	9.67E-18	3.58E-08	2.59E+06	4.32E-08
								Fines					
PU241	7.75E+04	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	1.54E-11	4.50E-04	8.67E-20	3.21E-10	2.59E+06	5.75E-12
Y 90	5.10E+04	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	1.01E-11	4.50E-04	2.20E-16	8.14E-07	2.59E+06	9.61E-09
PM147	2.57E+04	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	5.10E-12	4.50E-04	9.56E-19	3.54E-09	2.59E+06	2.10E-11
EU154	4.51E+03	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	8.95E-13	4.50E-04	6.81E-14	2.52E-04	2.59E+06	2.63E-07
CM244	5.57E+03	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	1.11E-12	4.50E-04	1.33E-17	4.92E-08	2.59E+06	6.34E-11
PU238	3.76E+03	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	7.46E-13	4.50E-04	1.27E-17	4.70E-08	2.59E+06	4.09E-11
SB125	1.99E+03	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	3.95E-13	4.50E-04	2.27E-14	8.40E-05	2.59E+06	3.87E-08
EU155	1.28E+03	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	2.54E-13	4.50E-04	2.95E-15	1.09E-05	2.59E+06	3.23E-09
AM241	8.06E+02	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	1.60E-13	4.50E-04	1.07E-15	3.96E-06	2.59E+06	7.38E-10
PU240	3.65E+02	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	7.25E-14	4.50E-04	1.23E-17	4.55E-08	2.59E+06	3.84E-12
PU239	1.99E+02	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	3.95E-14	4.50E-04	7.55E-18	2.79E-08	2.59E+06	1.29E-12
BA137M	7.38E+04	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	1.47E-11	4.50E-04	3.22E-14	1.19E-04	2.59E+06	2.03E-06
RH106	1.44E+04	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	2.86E-12	4.50E-04	1.16E-14	4.29E-05	2.59E+06	1.43E-07
CE144	8.14E+03	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	1.62E-12	4.50E-04	1.01E-15	3.74E-06	2.59E+06	7.04E-09
PR144	8.14E+03	10%	32	6.19E+06	1.28E-05	2.07E-12	1.00E+00	5.39E-08	4.50E-04	2.15E-15	7.96E-06	2.59E+06	4.99E-04
TE125M	4.86E+02	10%	32	6.19E+06	1.28E-05	2.07E-12	2.00E+00	6.44E-09	4.50E-04	8.48E-16	3.14E-06	2.59E+06	2.35E-05
												Total	1.59E-03

MPC-32													
Accident Conditions													
Effective Dose Equivalent From Submersion													
Nuclide	Inventory (Ci/Assy)	% remain airborne	No. Assy	MPC Vol (cm3)	L_{acc} Rate at Upstream (cm3/s)	Fraction Released per sec	Release Fraction	Release Rate (Ci/sec)	X/Q (sec/m3)	DCF (Sv/Bq)	DCF (mRem/uCi)	Occ Time (sec)	DDE (mRem)
								Gases					
H 3	2.97E+02	100%	32	6.19E+06	1.28E-05	2.07E-12	0.30	5.90E-09	4.50E-04	2.75E-18	1.02E-08	2.59E+06	6.99E-08
I129	2.64E-02	100%	32	6.19E+06	1.28E-05	2.07E-12	0.30	5.24E-13	4.50E-04	2.14E-16	7.92E-07	2.59E+06	4.84E-10
KR 85	4.82E+03	100%	32	6.19E+06	1.28E-05	2.07E-12	0.30	9.57E-08	4.50E-04	1.14E-16	4.22E-07	2.59E+06	4.70E-05
								Crud					
CO 60	2.18E+01	100%	32	6.19E+06	1.28E-05	2.07E-12	1.00	1.44E-09	4.50E-04	1.24E-13	4.59E-04	2.59E+06	7.70E-04
								Volatiles					
SR 90	5.10E+04	100%	32	6.19E+06	1.28E-05	2.07E-12	2.00E-04	6.75E-10	4.50E-04	6.44E-18	2.38E-08	2.59E+06	1.87E-08
RU106	1.44E+04	100%	32	6.19E+06	1.28E-05	2.07E-12	2.00E-04	1.91E-10	4.50E-04	0.00E+00	0.00E+00	2.59E+06	0.00E+00
CS134	3.01E+04	100%	32	6.19E+06	1.28E-05	2.07E-12	2.00E-04	3.98E-10	4.50E-04	7.37E-14	2.73E-04	2.59E+06	1.27E-04
CS137	7.82E+04	100%	32	6.19E+06	1.28E-05	2.07E-12	2.00E-04	1.03E-09	4.50E-04	6.68E-18	2.47E-08	2.59E+06	2.98E-08
								Fines					
PU241	7.75E+04	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	1.54E-11	4.50E-04	6.48E-20	2.40E-10	2.59E+06	4.30E-12
Y 90	5.10E+04	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	1.01E-11	4.50E-04	1.77E-16	6.55E-07	2.59E+06	7.73E-09
PM147	2.57E+04	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	5.10E-12	4.50E-04	5.45E-19	2.02E-09	2.59E+06	1.20E-11
EU154	4.51E+03	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	8.95E-13	4.50E-04	5.99E-14	2.22E-04	2.59E+06	2.31E-07
CM244	5.57E+03	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	1.11E-12	4.50E-04	7.08E-19	2.62E-09	2.59E+06	3.38E-12
PU238	3.76E+03	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	7.46E-13	4.50E-04	1.06E-18	3.92E-09	2.59E+06	3.41E-12
SB125	1.99E+03	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	3.95E-13	4.50E-04	1.95E-14	7.22E-05	2.59E+06	3.32E-08
EU155	1.28E+03	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	2.54E-13	4.50E-04	2.22E-15	8.21E-06	2.59E+06	2.43E-09
AM241	8.06E+02	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	1.60E-13	4.50E-04	6.74E-16	2.49E-06	2.59E+06	4.65E-10
PU240	3.65E+02	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	7.25E-14	4.50E-04	1.09E-18	4.03E-09	2.59E+06	3.41E-13
PU239	1.99E+02	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	3.95E-14	4.50E-04	2.65E-18	9.81E-09	2.59E+06	4.51E-13
BA137M	7.38E+04	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	1.47E-11	4.50E-04	2.80E-14	1.04E-04	2.59E+06	1.77E-06
RH106	1.44E+04	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	2.86E-12	4.50E-04	1.01E-14	3.74E-05	2.59E+06	1.25E-07
CE144	8.14E+03	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	1.62E-12	4.50E-04	7.69E-16	2.85E-06	2.59E+06	5.36E-09
PR144	8.14E+03	10%	32	6.19E+06	1.28E-05	2.07E-12	1.00E+00	5.39E-08	4.50E-04	1.90E-15	7.03E-06	2.59E+06	4.41E-04
TE125M	4.86E+02	10%	32	6.19E+06	1.28E-05	2.07E-12	2.00E+00	6.44E-09	4.50E-04	2.23E-16	8.25E-07	2.59E+06	6.19E-06
												Total	1.39E-03

MPC-32													
Accident Conditions													
Effective Dose Equivalent From Submersion													
Nuclide	Inventory (Ci/Assy)	% remain airborne	No. Assy	MPC Vol (cm3)	L_{acc} Rate at Upstream (cm3/s)	Fraction Released per sec	Release Fraction	Release Rate (Ci/sec)	X/Q (sec/m3)	DCF (Sv/Bq)	DCF (mRem/uCi)	Occ Time (sec)	DDE (mRem)
								Gases					
H 3	2.97E+02	100%	32	6.19E+06	1.28E-05	2.07E-12	0.30	5.90E-09	4.50E-04	0.00E+00	0.00E+00	2.59E+06	0.00E+00
I129	2.64E-02	100%	32	6.19E+06	1.28E-05	2.07E-12	0.30	5.24E-13	4.50E-04	1.64E-16	6.07E-07	2.59E+06	3.71E-10
KR 85	4.82E+03	100%	32	6.19E+06	1.28E-05	2.07E-12	0.30	9.57E-08	4.50E-04	1.09E-16	4.03E-07	2.59E+06	4.50E-05
								Crud					
CO 60	2.18E+01	100%	32	6.19E+06	1.28E-05	2.07E-12	1.00	1.44E-09	4.50E-04	1.23E-13	4.55E-04	2.59E+06	7.64E-04
								Volatiles					
SR 90	5.10E+04	100%	32	6.19E+06	1.28E-05	2.07E-12	2.00E-04	6.75E-10	4.50E-04	5.44E-18	2.01E-08	2.59E+06	1.58E-08
RU106	1.44E+04	100%	32	6.19E+06	1.28E-05	2.07E-12	2.00E-04	1.91E-10	4.50E-04	0.00E+00	0.00E+00	2.59E+06	0.00E+00
CS134	3.01E+04	100%	32	6.19E+06	1.28E-05	2.07E-12	2.00E-04	3.98E-10	4.50E-04	7.19E-14	2.66E-04	2.59E+06	1.24E-04
CS137	7.82E+04	100%	32	6.19E+06	1.28E-05	2.07E-12	2.00E-04	1.03E-09	4.50E-04	5.70E-18	2.11E-08	2.59E+06	2.54E-08
								Fines					
PU241	7.75E+04	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	1.54E-11	4.50E-04	5.63E-20	2.08E-10	2.59E+06	3.74E-12
Y 90	5.10E+04	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	1.01E-11	4.50E-04	1.62E-16	5.99E-07	2.59E+06	7.07E-09
PM147	2.57E+04	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	5.10E-12	4.50E-04	4.46E-19	1.65E-09	2.59E+06	9.81E-12
EU154	4.51E+03	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	8.95E-13	4.50E-04	5.87E-14	2.17E-04	2.59E+06	2.27E-07
CM244	5.57E+03	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	1.11E-12	4.50E-04	1.46E-18	5.40E-09	2.59E+06	6.96E-12
PU238	3.76E+03	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	7.46E-13	4.50E-04	1.68E-18	6.22E-09	2.59E+06	5.41E-12
SB125	1.99E+03	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	3.95E-13	4.50E-04	1.87E-14	6.92E-05	2.59E+06	3.18E-08
EU155	1.28E+03	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	2.54E-13	4.50E-04	1.85E-15	6.85E-06	2.59E+06	2.03E-09
AM241	8.06E+02	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	1.60E-13	4.50E-04	5.21E-16	1.93E-06	2.59E+06	3.59E-10
PU240	3.65E+02	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	7.25E-14	4.50E-04	1.65E-18	6.11E-09	2.59E+06	5.16E-13
PU239	1.99E+02	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	3.95E-14	4.50E-04	2.67E-18	9.88E-09	2.59E+06	4.55E-13
BA137M	7.38E+04	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	1.47E-11	4.50E-04	2.73E-14	1.01E-04	2.59E+06	1.72E-06
RH106	1.44E+04	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	2.86E-12	4.50E-04	9.75E-15	3.61E-05	2.59E+06	1.20E-07
CE144	8.14E+03	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	1.62E-12	4.50E-04	6.68E-16	2.47E-06	2.59E+06	4.65E-09
PR144	8.14E+03	10%	32	6.19E+06	1.28E-05	2.07E-12	1.00E+00	5.39E-08	4.50E-04	1.87E-15	6.92E-06	2.59E+06	4.34E-04
TE125M	4.86E+02	10%	32	6.19E+06	1.28E-05	2.07E-12	2.00E+00	6.44E-09	4.50E-04	1.86E-16	6.88E-07	2.59E+06	5.16E-06
												Total	1.37E-03

MPC-32 Accident Conditions Effective Dose Equivalent From Submersion													
Nuclide	Inventory (Ci/Assy)	% remain airborne	No. Assy	MPC Vol (cm3)	L_{acc} Rate at Upstream (cm3/s)	Fraction Released per sec	Release Fraction	Release Rate (Ci/sec)	X/Q (sec/m3)	DCF (Sv/Bq)	DCF (mRem/uCi)	Occ Time (sec)	DDE (mRem)
								Gases					
H 3	2.97E+02	100%	32	6.19E+06	1.28E-05	2.07E-12	0.30	5.90E-09	4.50E-04	0.00E+00	0.00E+00	2.59E+06	0.00E+00
I129	2.64E-02	100%	32	6.19E+06	1.28E-05	2.07E-12	0.30	5.24E-13	4.50E-04	1.10E-15	4.07E-06	2.59E+06	2.49E-09
KR 85	4.82E+03	100%	32	6.19E+06	1.28E-05	2.07E-12	0.30	9.57E-08	4.50E-04	2.20E-16	8.14E-07	2.59E+06	9.08E-05
								Crud					
CO 60	2.18E+01	100%	32	6.19E+06	1.28E-05	2.07E-12	1.00	1.44E-09	4.50E-04	1.78E-13	6.59E-04	2.59E+06	1.11E-03
								Volatiles					
SR 90	5.10E+04	100%	32	6.19E+06	1.28E-05	2.07E-12	2.00E-04	6.75E-10	4.50E-04	2.28E-17	8.44E-08	2.59E+06	6.64E-08
RU106	1.44E+04	100%	32	6.19E+06	1.28E-05	2.07E-12	2.00E-04	1.91E-10	4.50E-04	0.00E+00	0.00E+00	2.59E+06	0.00E+00
CS134	3.01E+04	100%	32	6.19E+06	1.28E-05	2.07E-12	2.00E-04	3.98E-10	4.50E-04	1.20E-13	4.44E-04	2.59E+06	2.06E-04
CS137	7.82E+04	100%	32	6.19E+06	1.28E-05	2.07E-12	2.00E-04	1.03E-09	4.50E-04	2.29E-17	8.47E-08	2.59E+06	1.02E-07
								Fines					
PU241	7.75E+04	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	1.54E-11	4.50E-04	2.19E-19	8.10E-10	2.59E+06	1.45E-11
Y 90	5.10E+04	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	1.01E-11	4.50E-04	4.44E-16	1.64E-06	2.59E+06	1.94E-08
PM147	2.57E+04	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	5.10E-12	4.50E-04	2.18E-18	8.07E-09	2.59E+06	4.80E-11
EU154	4.51E+03	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	8.95E-13	4.50E-04	9.43E-14	3.49E-04	2.59E+06	3.64E-07
CM244	5.57E+03	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	1.11E-12	4.50E-04	8.82E-18	3.26E-08	2.59E+06	4.21E-11
PU238	3.76E+03	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	7.46E-13	4.50E-04	9.30E-18	3.44E-08	2.59E+06	2.99E-11
SB125	1.99E+03	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	3.95E-13	4.50E-04	3.53E-14	1.31E-04	2.59E+06	6.01E-08
EU155	1.28E+03	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	2.54E-13	4.50E-04	8.09E-15	2.99E-05	2.59E+06	8.86E-09
AM241	8.06E+02	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	1.60E-13	4.50E-04	2.87E-15	1.06E-05	2.59E+06	1.98E-09
PU240	3.65E+02	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	7.25E-14	4.50E-04	9.26E-18	3.43E-08	2.59E+06	2.89E-12
PU239	1.99E+02	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	3.95E-14	4.50E-04	9.47E-18	3.50E-08	2.59E+06	1.61E-12
BA137M	7.38E+04	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	1.47E-11	4.50E-04	4.63E-14	1.71E-04	2.59E+06	2.93E-06
RH106	1.44E+04	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	2.86E-12	4.50E-04	1.72E-14	6.36E-05	2.59E+06	2.12E-07
CE144	8.14E+03	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	1.62E-12	4.50E-04	2.49E-15	9.21E-06	2.59E+06	1.74E-08
PR144	8.14E+03	10%	32	6.19E+06	1.28E-05	2.07E-12	1.00E+00	5.39E-08	4.50E-04	2.99E-15	1.11E-05	2.59E+06	6.95E-04
TE125M	4.86E+02	10%	32	6.19E+06	1.28E-05	2.07E-12	2.00E+00	6.44E-09	4.50E-04	1.22E-15	4.51E-06	2.59E+06	3.39E-05
												Total	2.13E-03

MPC-32													
Accident Conditions													
Effective Dose Equivalent From Submersion													
Nuclide	Inventory (Ci/Assy)	% remain airborne	No. Assy	MPC Vol (cm3)	L_{acc} Rate at Upstream (cm3/s)	Fraction Released per sec	Release Fraction	Release Rate (Ci/sec)	X/Q (sec/m3)	DCF (Sv/Bq)	DCF (mRem/uCi)	Occ Time (sec)	DDE (mRem)
								Gases					
H 3	2.97E+02	100%	32	6.19E+06	1.28E-05	2.07E-12	0.30	5.90E-09	4.50E-04	0.00E+00	0.00E+00	2.59E+06	0.00E+00
I129	2.64E-02	100%	32	6.19E+06	1.28E-05	2.07E-12	0.30	5.24E-13	4.50E-04	3.86E-16	1.43E-06	2.59E+06	8.72E-10
KR 85	4.82E+03	100%	32	6.19E+06	1.28E-05	2.07E-12	0.30	9.57E-08	4.50E-04	1.18E-16	4.37E-07	2.59E+06	4.87E-05
								Crud					
CO 60	2.18E+01	100%	32	6.19E+06	1.28E-05	2.07E-12	1.00	1.44E-09	4.50E-04	1.27E-13	4.70E-04	2.59E+06	7.89E-04
								Volatiles					
SR 90	5.10E+04	100%	32	6.19E+06	1.28E-05	2.07E-12	2.00E-04	6.75E-10	4.50E-04	7.33E-18	2.71E-08	2.59E+06	2.13E-08
RU106	1.44E+04	100%	32	6.19E+06	1.28E-05	2.07E-12	2.00E-04	1.91E-10	4.50E-04	0.00E+00	0.00E+00	2.59E+06	0.00E+00
CS134	3.01E+04	100%	32	6.19E+06	1.28E-05	2.07E-12	2.00E-04	3.98E-10	4.50E-04	7.57E-14	2.80E-04	2.59E+06	1.30E-04
CS137	7.82E+04	100%	32	6.19E+06	1.28E-05	2.07E-12	2.00E-04	1.03E-09	4.50E-04	7.55E-18	2.79E-08	2.59E+06	3.37E-08
								Fines					
PU241	7.75E+04	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	1.54E-11	4.50E-04	6.98E-20	2.58E-10	2.59E+06	4.63E-12
Y 90	5.10E+04	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	1.01E-11	4.50E-04	1.87E-16	6.92E-07	2.59E+06	8.16E-09
PM147	2.57E+04	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	5.10E-12	4.50E-04	6.75E-19	2.50E-09	2.59E+06	1.49E-11
EU154	4.51E+03	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	8.95E-13	4.50E-04	6.15E-14	2.28E-04	2.59E+06	2.37E-07
CM244	5.57E+03	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	1.11E-12	4.50E-04	4.19E-18	1.55E-08	2.59E+06	2.00E-11
PU238	3.76E+03	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	7.46E-13	4.50E-04	4.01E-18	1.48E-08	2.59E+06	1.29E-11
SB125	1.99E+03	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	3.95E-13	4.50E-04	2.01E-14	7.44E-05	2.59E+06	3.42E-08
EU155	1.28E+03	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	2.54E-13	4.50E-04	2.41E-15	8.92E-06	2.59E+06	2.64E-09
AM241	8.06E+02	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	1.60E-13	4.50E-04	7.83E-16	2.90E-06	2.59E+06	5.40E-10
PU240	3.65E+02	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	7.25E-14	4.50E-04	3.92E-18	1.45E-08	2.59E+06	1.22E-12
PU239	1.99E+02	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	3.95E-14	4.50E-04	3.88E-18	1.44E-08	2.59E+06	6.61E-13
BA137M	7.38E+04	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	1.47E-11	4.50E-04	2.88E-14	1.07E-04	2.59E+06	1.82E-06
RH106	1.44E+04	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	2.86E-12	4.50E-04	1.03E-14	3.81E-05	2.59E+06	1.27E-07
CE144	8.14E+03	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	1.62E-12	4.50E-04	8.33E-16	3.08E-06	2.59E+06	5.80E-09
PR144	8.14E+03	10%	32	6.19E+06	1.28E-05	2.07E-12	1.00E+00	5.39E-08	4.50E-04	1.95E-15	7.22E-06	2.59E+06	4.53E-04
TE125M	4.86E+02	10%	32	6.19E+06	1.28E-05	2.07E-12	2.00E+00	6.44E-09	4.50E-04	4.64E-16	1.72E-06	2.59E+06	1.29E-05
												Total	1.44E-03

Nuclide	Inventory (Ci/Assy)	% remain airborne	No. Assy	MPC Vol (cm3)	L_{acc} Rate at Upstream (cm3/s)	Fraction Released per sec	Release Fraction	Release Rate (Ci/sec)	X/Q (sec/m3)	DCF (Sv/Bq)	DCF (mRem/uCi)	Occ Time (sec)	DDE (mRem)
MPC-32													
Accident Conditions													
Effective Dose Equivalent From Submersion													
								Gases					
H 3	2.97E+02	100%	32	6.19E+06	1.28E-05	2.07E-12	0.30	5.90E-09	4.50E-04	3.31E-19	1.22E-09	2.59E+06	8.42E-09
I129	2.64E-02	100%	32	6.19E+06	1.28E-05	2.07E-12	0.30	5.24E-13	4.50E-04	3.80E-16	1.41E-06	2.59E+06	8.59E-10
KR 85	4.82E+03	100%	32	6.19E+06	1.28E-05	2.07E-12	0.30	9.58E-08	4.50E-04	1.19E-16	4.40E-07	2.59E+06	4.91E-05
								Crud					
CO 60	2.18E+01	100%	32	6.19E+06	1.28E-05	2.07E-12	1.00	1.44E-09	4.50E-04	1.26E-13	4.66E-04	2.59E+06	7.83E-04
								Volatiles					
SR 90	5.10E+04	100%	32	6.19E+06	1.28E-05	2.07E-12	2.00E-04	6.75E-10	4.50E-04	7.53E-18	2.79E-08	2.59E+06	2.19E-08
RU106	1.44E+04	100%	32	6.19E+06	1.28E-05	2.07E-12	2.00E-04	1.91E-10	4.50E-04	0.00E+00	0.00E+00	2.59E+06	0.00E+00
CS134	3.01E+04	100%	32	6.19E+06	1.28E-05	2.07E-12	2.00E-04	3.99E-10	4.50E-04	7.57E-14	2.80E-04	2.59E+06	1.30E-04
CS137	7.82E+04	100%	32	6.19E+06	1.28E-05	2.07E-12	2.00E-04	1.04E-09	4.50E-04	7.74E-18	2.86E-08	2.59E+06	3.46E-08
								Fines					
PU241	7.75E+04	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	1.54E-11	4.50E-04	7.25E-20	2.68E-10	2.59E+06	4.81E-12
Y 90	5.10E+04	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	1.01E-11	4.50E-04	1.90E-16	7.03E-07	2.59E+06	8.30E-09
PM147	2.57E+04	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	5.11E-12	4.50E-04	6.93E-19	2.56E-09	2.59E+06	1.53E-11
EU154	4.51E+03	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	8.96E-13	4.50E-04	6.14E-14	2.27E-04	2.59E+06	2.37E-07
CM244	5.57E+03	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	1.11E-12	4.50E-04	4.91E-18	1.82E-08	2.59E+06	2.34E-11
PU238	3.76E+03	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	7.47E-13	4.50E-04	4.88E-18	1.81E-08	2.59E+06	1.57E-11
SB125	1.99E+03	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	3.95E-13	4.50E-04	2.02E-14	7.47E-05	2.59E+06	3.44E-08
EU155	1.28E+03	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	2.54E-13	4.50E-04	2.49E-15	9.21E-06	2.59E+06	2.73E-09
AM241	8.06E+02	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	1.60E-13	4.50E-04	8.18E-16	3.03E-06	2.59E+06	5.65E-10
PU240	3.65E+02	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	7.25E-14	4.50E-04	4.75E-18	1.76E-08	2.59E+06	1.49E-12
PU239	1.99E+02	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	3.95E-14	4.50E-04	4.24E-18	1.57E-08	2.59E+06	7.23E-13
BA137M	7.38E+04	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	1.47E-11	4.50E-04	2.88E-14	1.07E-04	2.59E+06	1.82E-06
RH106	1.44E+04	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	2.86E-12	4.50E-04	1.04E-14	3.85E-05	2.59E+06	1.28E-07
CE144	8.14E+03	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	1.62E-12	4.50E-04	8.53E-16	3.16E-06	2.59E+06	5.95E-09
PR144	8.14E+03	10%	32	6.19E+06	1.28E-05	2.07E-12	1.00E+00	5.39E-08	4.50E-04	1.95E-15	7.22E-06	2.59E+06	4.53E-04
TE125M	4.86E+02	10%	32	6.19E+06	1.28E-05	2.07E-12	2.00E+00	6.44E-09	4.50E-04	4.53E-16	1.68E-06	2.59E+06	1.26E-05
												Total	1.43E-03

Sub-Skin

MPC-32													
Accident Conditions													
Effective Dose Equivalent From Submersion													
Nuclide	Inventory (Ci/Assy)	% remain airborne	No. Assy	MPC Vol (cm3)	L_{acc} Rate at Upstream (cm3/s)	Fraction Released per sec	Release Fraction	Release Rate (Ci/sec)	X/Q (sec/m3)	DCF (Sv/Bq)	DCF (mRem/uCi)	Occ Time (sec)	SDE (mRem)
								Gases					
H 3	2.97E+02	100%	32	6.19E+06	1.28E-05	2.07E-12	0.30	5.90E-09	4.50E-04	0.00E+00	0.00E+00	2.59E+06	0.00E+00
I129	2.64E-02	100%	32	6.19E+06	1.28E-05	2.07E-12	0.30	5.24E-13	4.50E-04	1.10E-15	4.07E-06	2.59E+06	2.49E-09
KR 85	4.82E+03	100%	32	6.19E+06	1.28E-05	2.07E-12	0.30	9.57E-08	4.50E-04	1.32E-14	4.88E-05	2.59E+06	5.45E-03
								Crud					
CO 60	2.18E+01	100%	32	6.19E+06	1.28E-05	2.07E-12	1.00	1.44E-09	4.50E-04	1.45E-13	5.37E-04	2.59E+06	9.01E-04
								Volatiles					
SR 90	5.10E+04	100%	32	6.19E+06	1.28E-05	2.07E-12	2.00E-04	6.75E-10	4.50E-04	9.20E-15	3.40E-05	2.59E+06	2.68E-05
RU106	1.44E+04	100%	32	6.19E+06	1.28E-05	2.07E-12	2.00E-04	1.91E-10	4.50E-04	0.00E+00	0.00E+00	2.59E+06	0.00E+00
CS134	3.01E+04	100%	32	6.19E+06	1.28E-05	2.07E-12	2.00E-04	3.98E-10	4.50E-04	9.45E-14	3.50E-04	2.59E+06	1.62E-04
CS137	7.82E+04	100%	32	6.19E+06	1.28E-05	2.07E-12	2.00E-04	1.03E-09	4.50E-04	8.63E-15	3.19E-05	2.59E+06	3.85E-05
								Fines					
PU241	7.75E+04	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	1.54E-11	4.50E-04	1.17E-19	4.33E-10	2.59E+06	7.76E-12
Y 90	5.10E+04	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	1.01E-11	4.50E-04	6.24E-14	2.31E-04	2.59E+06	2.72E-06
PM147	2.57E+04	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	5.10E-12	4.50E-04	8.11E-16	3.00E-06	2.59E+06	1.78E-08
EU154	4.51E+03	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	8.95E-13	4.50E-04	8.29E-14	3.07E-04	2.59E+06	3.20E-07
CM244	5.57E+03	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	1.11E-12	4.50E-04	3.91E-17	1.45E-07	2.59E+06	1.86E-10
PU238	3.76E+03	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	7.46E-13	4.50E-04	4.09E-17	1.51E-07	2.59E+06	1.32E-10
SB125	1.99E+03	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	3.95E-13	4.50E-04	2.65E-14	9.81E-05	2.59E+06	4.51E-08
EU155	1.28E+03	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	2.54E-13	4.50E-04	3.39E-15	1.25E-05	2.59E+06	3.71E-09
AM241	8.06E+02	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	1.60E-13	4.50E-04	1.28E-15	4.74E-06	2.59E+06	8.83E-10
PU240	3.65E+02	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	7.25E-14	4.50E-04	3.92E-17	1.45E-07	2.59E+06	1.22E-11
PU239	1.99E+02	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	3.95E-14	4.50E-04	1.86E-17	6.88E-08	2.59E+06	3.17E-12
BA137M	7.38E+04	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	1.47E-11	4.50E-04	3.73E-14	1.38E-04	2.59E+06	2.36E-06
RH106	1.44E+04	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	2.86E-12	4.50E-04	1.09E-13	4.03E-04	2.59E+06	1.34E-06
CE144	8.14E+03	10%	32	6.19E+06	1.28E-05	2.07E-12	3.00E-05	1.62E-12	4.50E-04	2.93E-15	1.08E-05	2.59E+06	2.04E-08
PR144	8.14E+03	10%	32	6.19E+06	1.28E-05	2.07E-12	1.00E+00	5.39E-08	4.50E-04	8.43E-14	3.12E-04	2.59E+06	1.96E-02
TE125M	4.86E+02	10%	32	6.19E+06	1.28E-05	2.07E-12	2.00E+00	6.44E-09	4.50E-04	1.94E-15	7.18E-06	2.59E+06	5.39E-05
												Total	2.62E-02

Appendix B

Correspondence with PG&E

Diablo Canyon Specification 10012-N-NPG Section 6.2.10 (2 pages)
September 28, 200 letter to Eric Lewis from Richard Klimczak (5 pages)
October 11, 2000 letter to Eric Lewis from Richard Klimczak (5 pages)
October 19, 2000 letter to Eric Lewis from Richard Klimczak (5 pages)
January 8, 2001 email to Eric Lewis from Richard Klimczak (3 pages)

(Total of 21 pages including this cover page)

— (PROPRIETARY INFORMATION) —

(PROPRIETARY INFORMATION)

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NEW JERSEY OFFICE

September 28th, 2000

Kris –
Per your request.
If you need any of the attachments let me know
EL 9/28/00

Mr. Eric Lewis
Project Manager
Holtec International
Holtec Center
555 Lincoln Drive West
Marlton, New Jersey 08053

PG&E

Subject: Diablo Canyon ISFSI Project - Diablo Canyon Units 1 and 2
Transmittal of Analysis Inputs

Reference:
1) E/mail from Holtec (E. Lewis) to PG&E (Patton and Klimczak) of 9/19/00
2) E/mail from Holtec (E. Lewis) to PG&E (Patton and Klimczak) of 9/22/00

Dear Eric,

Enclosed please find for your use as design inputs.

Please confirm receipt of the package at your convenience via e/mail to rlk1@pge.com.

If you have any questions regarding this information, please contact me @ 805-595-6321.

Sincerely,

Richard L. Klimczak
Project Engineer
Diablo Canyon Used Fuel Storage Project

jxt3

cc:

TLGrebel	DCPP 104 (w/o)
RDHagler	SLO B13 (w/o)
CAHartz	DCPP 104 (w/o)
PWHuang	DCPP 201 (w/o)
BHPatton	DCPP 104 (w/o)
EOOlweny	SLO B9 (w/o)
TPLee	SLO B12 (w/o)
LJStrickland	SLO B03 (w/o)
AFTafoya	SLO B10 (w/o)
DCPP RMS	DCPP 119/1 (w/o)
DCPP File No. 72.10.05 (w/o)	
DCPP Chronological File	

Enclosures:
1) Response to Holtec Questions
2) Copy of E-mail references

cc: BRPhillips SFGO 77/24 (w/o 1&2)

September 28th 2000

Response to 9/19/2000 E-mail:

The following X/Q numbers should be used for the normal and off-normal conditions. Please note these numbers accounted for the frequency the wind actually blown to the sectors.

NW - 3.44X10-6	NNW - 2.70X10-6	N - 1.51X10-6
NNE - 8.25X10-7	NE - 1.62X10-7	ENE - 9.18X10-8
E - 1.07X10-7	ESE - 5.20X10-7	SE - 1.32X10-6

PG&E References: 1999 annual Radioactive Effluent Release Report dated 4/28/2000 (PG&E letter DCL-00-061).

Response to 9/22/2000 E-mail:

Item 1: Procedure RP1.ID5 is attached.

Item 2: 4400 is the correct number to use. This is based on adding numbers from Spec. sections 3.1.1.1, 3.2.3 and 3.2.4 and rounded up to 4400.

Item 3: The estimated annual dose to the public for normal operation is shown on pages 39, 40 and 41 of the attached DCPP 1999 Annual Radioactive Effluent Release Report.

Item 4: Use 8760 hours (Full Occupancy) for your off-site dose calculation.

PG&E Reference: NRC's Interim Staff Guidance Memorandum (ISG) No. 13, " Real Individual ", Revision 0.dated May 2000(attached).

Item 5:

The minimum distance from the nearest cask location on the ISFSI pad to the nearest site boundary, exclusion area boundary, or unrestricted area boundary is 1325 ft.

PG&E Reference: Fig. 6.4-1, pg. 132, Spec. 10012-N-NPG

Item 6:

The minimum distance from the nearest cask location on the ISFSI pad to a normally occupied location within DCPP is:

Location - Make-up water Facility
Distance - 300 ft

Additional data:

Minimum distance from the nearest cask location on the ISFSI pad to a temporary occupied location related to ISFSI:

Location - Cask Transfer Facility
Distance - 200 ft

Location - Security Booth
Distance - 80 ft

PG&E Reference: Drawings 496635, 474938 and Fig. 6.4-1 of the Spec

Item 7:

The distance and direction to the nearest permanent resident are:

Distance - 1.5 miles
Direction - N-NW
Occupancy - 2 Persons

PG&E References: ISFSI SAR, Section 2.1.3.1, Information verified.

Klimczak, Richard

From: Eric Lewis [Eric_Lewis@holtec.com]
Sent: Tuesday, September 19, 2000 8:47 AM
To: Patton, Bruce Klimczak, Richard
Cc: kris_cummings@holtec.com; Everett Redmond
Subject: X/Q info request

Bruce, Rich -

Kris Cummings had the following comment and requests your concurrence with
the methodology and needs a annual average X/Q. We will need a response by
the 29th of September if possible.

>Section 6.2.10 provides an acceptable atmospheric dispersion factor (X/Q) to
>calculate the doses under accident conditions at the minimum site boundary
>due to an effluent release. The value of 4.5x10^-4 sec/m^2 is appropriate
>for this calculation and the accident condition doses will be compared to
>limits in 10CFR72.106(b). However, this value is not appropriate for
>calculating the doses under normal and off-normal conditions for comparison
>with 10CFR72.104(a). DCPP will need to provide an annual average X/Q
>value for use at the controlled area boundary of approximately 800 meters.

Let me know if you can meet the scheduled need or if you need further clarification.

Eric

Eric G Lewis
Project Manager
Holtec International
Holtec Center
www.holtecinternational.com
555 Lincoln Drive West
Marlton, NJ 08053

Tel: (856) 797-0900, ext. 645
Fax: (856) 797-0909
E-Mail: Eric_Lewis@holtec.com
Holtec Website:

Klimczak, Richard

From: Eric Lewis [Eric_Lewis@holtec.com]
Sent: Friday, September 22, 2000 1:21 PM
To: Patton, Bruce; Klimczak, Richard
Subject: Request For Info for Shielding Evaluation

Bruce & Rich -

This is the wish list from our shielding guys.

1. Please provide a copy of PG&E procedure RP1.ID6.
2. Section 3.2.3 and 3.2.4 imply that the number of assemblies to be stored is approximately 4090. Section 6.1.14 item 2.IV.B.i and Section 6.4.4.1 state that up to 4400 assemblies may be stored on the ISFSI. Please confirm that 4400 is the correct number of assemblies to be using for the ISFSI calculations.
3. Please provide the estimated annual dose to the public beyond the controlled area boundary as a result of DCPP normal operation. This value is needed to demonstrate compliance with 10CFR72.104.
4. Please provide the occupancy factor to be used in the calculation of the off-site dose rate, 8760 hours (full occupancy) or 2000 hours (40 hour work week).
5. Please provide the minimum distance from the ISFSI to the controlled area boundary that is to be used in the calculations.
6. Please provide the minimum distance from the ISFSI to a normally occupied location within the DCPP.
7. Please provide the distance and direction to the nearest permanent resident. This information may only be used to further indicate the conservatism and low radiation exposure to the public.

Please provide this information as soon as possible. Appreciate you help!

Thanks,

Eric

Eric G Lewis
Project Manager
Holtec International
Holtec Center
555 lincoln Drive West
Marlton, NJ 08053

Tel: (856) 797-0900, ext. 645
Fax: (856) 797-0909
E-Mail: Eric_Lewis@holtec.com
Holtec Website: www.holtecinternational.com

Pacific Gas and Electric Company

DCPP Used Fuel Storage Project
Used Fuel Storage Program
Nuclear Services
Generation

Diablo Canyon Power Plant
Mail Code SLO 408/B
408 Higuera Street
San Luis Obispo, CA 93401

(805) 595-6384
(805) 595-6402 (FAX)

October 11, 2000

Mr. Eric Lewis
Project Manager
Holtec International
Holtec Center
555 Lincoln Drive West
Marlton, New Jersey 08053

Subject: Diablo Canyon ISFSI Project – Diablo Canyon Units 1 and 2
Transmittal of Analysis Inputs

Reference:
1) E-mail from Holtec (E. Lewis) to PG&E (Patton and Klimczak) of 9/11/00
2) E-mail from Holtec (E. Rosenbaum) to PG&E (Patton) of 9/25/00
3) E-mail from Holtec (E. Lewis) to PG&E (Patton and Klimczak) of 9/29/00
4) E-mail from Holtec (E. Lewis) to PG&E (Patton and Klimczak) of 10/6/00

Dear Eric,

Enclosed please find for your use as design inputs and review of draft SFP thermal evaluation.

Please confirm receipt of the package at your convenience via e/mail to rlk1@pge.com.

If you have any questions regarding this information, please contact me @ 805-595-6321.

Sincerely,

Richard L. Klimczak
Project Engineer
Diablo Canyon Used Fuel Storage Project

cc:				
	TLGrebel	SLO BA (w/o)	TPLee	SLO B12 (w/o)
	RDHagler	SLO B13 (w/o)	LJStrickland	SLO B1 (w/o)
	CAHartz	SLO B4 (w/o)	AFTafoya	SLO B11 (w/o)
	PWHuang	DCPP 201 (w/o)	DCPP RMS	DCPP 119/1 (w/o)
	BHPatton	SLO BB (w/o)	DCPP File No. 72.10.05 (w/o)	
	EOOlweny	SLO B6 (w/o)	DCPP Chronological File	

Enclosures: 1) Response to Holtec Questions
2) Copy of E-mail references
3) Comments on draft SFP thermal evaluation

cc: BRPhillips SFGO 77/24 (w/o 1&2)

October 11, 2000

Response to 9/11/2000 E-mail (item #4 and item #14):

Item #4: Added PG&E reference: Westinghouse letter 00PGE-G-0083.

Item#14: Aux. Bldg. Floor Slab Stiffnesses

1. For Cask Recess area in SFP: 157,000 K/in (based on underlying rock properties)
2. For 2' thick Slab in cask washdown area: 27,600 K/in)
3. For 2'-6" thick slab in the receiving/shipping area: 26,400 K/in

Please note that these stiffnesses are all in the vertical (out of plane) directions of the respective slabs. The cask washdown area stiffness is based on a bounding corner drop. For the receiving shipping area, the stiffness is based on a side drop.

Description of corner and side drops:

i. The Cask is assumed to have a flat drop on the slab with the Cask against the wall, i.e. the cask bottom surface imparts a uniformly distributed vertical impact load on the slab.

ii. The side drop is a drop of the Cask at the E-W centerline of either the Cask Washdown or Shipping/Receiving areas, but with the Cask against the west wall of the Cask Washdown and Shipping/Receiving areas. The west wall is on column line "T" on the floor plan drawings (e.g. see Dwgs. 438432 and 439533 for Units 1 and 2 respectively, or other area plan dwg.)

iii. The corner drop is a Cask drop in the Cask Washdown area with the edge of the Cask landing just west of the face of the supporting wall located below the slab, and with the Cask against the SFP wall. The supporting wall below runs N-S and is located about midway of the Cask Washdown area in the E-W dir. (e.g. see Dwgs 438432 and 439533 for Units 1 and 2, respectively).

Note: A corner drop at the NW corner of the Unit 1 Cask Washdown area (SW for Unit 2) is disregarded due to the existing concrete enclosure, which protects piping running vertically against the walls in the corner.

PG&E References: PG&E Calculation No. 52-15-122.

Response to 9/25/2000 E-mail:

Review of draft SFP thermal evaluation (Holtec Report HI-2002494). PG&E's comments are shown on the attached copy of the subject report. Copies of PG&E dwgs: 695034-30 Rev. 2 and 695034-31 Rev. 2 are provided.

Additional Comments:

The final evaluation should be submitted as a Holtec calculation.

October 11, 2000

Response to 9/29/2000 E-mail:

Subject: Diablo Canyon Missile
Date: 9/29/2000
Questions by: Eric Lewis

Questions:

1. Please confirm that the impact velocity of 240 mph is correct for the tornado missiles from the 500 kV towers (refer to Spec. Para. 6.2.2.5 III). In light of the recent changes, there is a question as to whether this velocity should be reduced to 157 mph.

2. Please specify the material of the 750-lb insulator string (refer to Spec. Para. 6.2.2.5 III).

3. Please provide the dimensions of the 750-lb insulator string. In particular, I need to know the impact footprint (i.e., will it impact the cask over a 6" diameter? 12" diameter? ...).

Answers:

i. Tower Missile Impact Velocity:

Tornado missiles originating from 500 kV towers shall be conservatively assumed to equal the tornado rotational speed of 157 mph (based on the required 200 mph tornado – Rev.1 of Spec.) If results based on this bounding assumption are unacceptable then the missile impact velocity may be calculated based on the missile physical properties as provided below to yield less conservative impact forces.

ii. Suspension Insulator Properties:

Type:	Fog Type Ball-Socket		
ANSI Std. C.29.2 92:	Class 52-5	(Table 3 & Fig. 2)	
Connecting hardware:	B & S, Type J		
Dimensions:			
	Shell diameter (B)	-	10" to 10-1/2" (Range)
	Unit spacing (A)	-	5-3/4" (See fig. 2, ANSI C29.2)
No. of insulators per string:	48	(per PG&E dwg. 331919)	
Weight:	15.5 lbs per insulator, 15 lbs yoke wt. (approx.) Total wt. = 760 lbs, per string		
Materials:			
	Insulator Shell	-	High Strength Porcelain (Impact strength = 90 in-lbs)
	Socket Cap	-	Malleable Iron (Hot-dip Galvanized)
	Socket Key	-	Brass
	Ball Pin	-	Forged Steel (Hot-dip Galvanized)

October 11, 2000

3. Additional notes:

A further brief description of the suspension insulation may be found in ANSI C29.2.

The impact area would likely be either the porcelain shell perimeter or the metallic socket cap, which by proportion has a diameter of approx. 2-inches. Impact by either the porcelain shells or metal ends of the string should be considered in determining the bounding impact load.

4. PG&E References:

i. PG&E Drawings:

Dwg. 331919 - "Insulator Strings Diablo Canyon P.P. - Switchyard Tie, 500 kV Transmission Lines", Rev. 6.

Dwg. 0154014, Table 12 - "Suspension Type Insulators", pg. 13, Rev. 0, 03-21-97

ii. ANSI C29.2-1992: "American National Standard for Insulators - Wet-Process Porcelain and Toughened Glass-Suspension Type".

iii. The Ohio Brass Company Catalog 60, Pg. 25, "Extended Leakage Suspension Insulators", Futura, Ball-Socket Number 47414 (Code 31-4079, Catalog No.: 47414 -3311 & 3310)

iv. Locke Insulators catalog, Pg. 12: "30,000 lb. M&E', (Code 31-4079, Catalog No. 305263 HLD).

<u>Response to 10/6/2000 E-mail:</u>

X/Q values are not provided for the other seven sectors since they are over the water (sectors are considered to be unoccupied).

PG&E Reference: TES Report No. 420DC-00.19 - " 1999 Annual Radiological Environmental Operating Report "

1073
D

Pacific Gas and Electric Company

DCPP Used Fuel Storage Project
Used Fuel Storage Program
Nuclear Services
Generation

Diablo Canyon Power Plant
Mail Code SLO 406/8
406 Higuera Street
San Luis Obispo, CA 93401

(805) 595-8388
(805) 595-8402 (FAX)

October 19, 2000

Mr. Eric Lewis
Project Manager
Holtec International
Holtec Center
555 Lincoln Drive West
Marlton, New Jersey 08053

RECEIVED
OCT 20 2000
HOLTEC INTERNATIONAL
NEW JERSEY OFFICE

Subject: Diablo Canyon ISFSI Project – Diablo Canyon Units 1 and 2
Transmittal of Analysis Inputs and Technical Review Comments

Reference:
1) E-mail from Holtec (E. Lewis) to PG&E (Patton and Klimczak) of 10/6/00
2) E-mail from Holtec (E. Lewis) to PG&E (Patton and Klimczak) of 10/11/00
3) Holtec "Design Criteria Document for Cask Seismic/Structural Analyses for DCPP". Holtec Report No: 2002478

Dear Eric,

Enclosed please find for your use design inputs and review comments on Holtec Report No. 2002478.

Please confirm receipt of the package at your convenience via e/mail to rlk1@pge.com.

If you have any questions regarding this information, please contact me @ 805-595-6321.

Sincerely,

Richard L. Klimczak
Project Engineer
Diablo Canyon Used Fuel Storage Project

cc:

TLGrebel	SLO BA (w/o)	TPLee	SLO B12 (w/o)
RDHagler	SLO B13 (w/o)	LJStrickland	SLO B1 (w/o)
CAHartz	SLO B4 (w/o)	AFTafoya	SLO B11 (w/o)
PWHuang	DCPP 201 (w/o)	DCPP RMS	DCPP 119/1 (w/o)
BHPatton	SLO BB (w)	DCPP File No. 72.10.05 (w/o)	
EOO'weny	SLO B6 (w/c)	DCPP Chronological File	

Enclosures: 1) Response to Holtec Questions
2) Copy of E-mail references
3) Comments on Holtec Report No. 2002478

cc: BRPhillips SFGO 77/24 (w/o 1&2)

kmn

October 19, 2000

Response to 10/06/2000 E-mail:

Add to PG&E Reference: Mark Somerville to Tien Lee e-mail dated 10/11/2000.

Response to 10/11/2000 E-mail:

Item 1: The letter of September 28 is accurate. Section 6.2.10 will be revised to state that: " the distance to the nearest plant boundary is approximately 400 meters."

PG&E Reference: Dwg. 471124 Rev. 1.

Item 2: The letter of September 28 is accurate.

Item 3: The letter of September 28 is accurate. The X/Q value of ~~X/Q of~~ 4.5x10-4 is appropriate to use the 403 meters to the nearest site boundary.

Review Comments to Holtec Report No. HI-2002478 received by PG&E on 9/18/2000:

Attached are PG&E's review comments, based on PG&E's Specification 10012-N-NPG, on the subject repo "Design Criteria Document For Cask Seismic/Structural Analyses For DCPP".

Klimczak, Richard

From: Eric Lewis [Eric_Lewis@holtec.com]
Sent: Friday, October 06, 2000 12:44 PM
To: Patton, Bruce; Klimczak, Richard
Subject: Fwd: Atmospheric Dispersion Factors

Response 10/11

Bruce/Rich -

I little help again please.

Eric

X-Sender: eric_lewis@holtec.com@mail.holtec.com
X-Mailer: QUALCOMM Windows Eudora Pro Version 4.1
Date: Mon, 08 Jan 2001 09:32:18 -0500
To: Everett Redmond <Everett_Redmond@holtec.com>,kris_cummings@holtec.com
From: Eric <eric_lewis@holtec.com>
Subject: Fwd: FW: Questions on New ISFSI Layout

From: "Klimczak, Richard" <RLK1@pge.com>
To: "'eric_lewis@holtec.com'" <eric_lewis@holtec.com>
Cc: "'brian_gutherman@holtec.com'" <brian_gutherman@holtec.com>, "Patton, Bruce" <BHP1@pge.com>, "Tafoya, Albert" <AFT2@pge.com>, "Strickland, L Jearl" <LJS2@pge.com>, "Vitkus, Darius" <DVV3@pge.com>, "Grebel, Terence" <TLG1@pge.com>, "Hartz, Christopher" <CEH1@pge.com>, "Olweny, Edwin" <EOO2@pge.com>
Subject: FW: Questions on New ISFSI Layout
Date: Fri, 5 Jan 2001 16:51:35 -0800
X-Mailer: Internet Mail Service (5.5.2650.21)

Eric,

The following our PG&E's responses to Holtec's questions in your 12/18/00 e-mail to us regarding distances and dimensions from the new ISFSI layout:

Answers are based on PG&E Dwg. 471124 Rev. 1 and Dwg. 4016849 Rev. 0. <?xml:namespace prefix = o ns = "urn:schemas-microsoft-com:office:office" />

1 - What is the shortest distance from the new ISFSI to the site boundary? **1400 ft**

2 - What is the shortest distance from the new ISFSI to the nearest occupied location (the water makeup facility)? **223 ft**

3 - Please confirm that the nominal pitch of the HI-STORM overpacks will not exceed 17 feet even though the pads will be constructed as needed? **Yes, the nominal pitch of the HI-STORM overpacks will not exceed 17 feet.**

4 - What is the shortest distance from the new ISFSI to the area around the reactor building ? This number will be used for estimating occupational exposure from the ISFSI. **The shortest distance from the new ISFSI to the nearest Aux. Building Wall is 798 ft.**

5- What is the distance to the nearest resident from the ISFSI? **1.5 miles (same as previously as this is a conservative distance that bounds both the new and old ISFSI pad locations)**

6 - What is the shortest distance from the CTF to the site boundary? **1625 ft**

7 - What is the shortest distance from the CTF to the nearest occupied location (the water makeup facility)? **669 ft**

8 - What is the shortest distance from the CTF to the area around the reactor building? This number will be used for estimating occupational exposure from the CTF. **The shortest**

distance from the CTF to the nearest Aux. Building Wall is 740 ft.

9 - What is the distance to the nearest resident from the CTF? **1.5 miles**

This information will also be transmitted to you via a letter.

Rich Klimczak
DCPP Used Fuel Storage Project
Project Engineer
(805) 595-6321

-----Original Message-----
From: Eric [mailto:eric_lewis@holtec.com]
Sent: Monday, December 18, 2000 2:41 PM
To: Patton, Bruce
Cc: Klimczak, Richard; Strickland, L Jearl
Subject: Fwd: Questions on New ISFSI Layout

Appendix C

Documentation for Selection of the Design Basis Assembly

(Holtec International Proprietary Information)

HOLTEC INTERNATIONAL
Holtec Center, 555 Lincoln Drive West, Marlton, NJ 08053
Telephone (856) 797- 0900
Fax (856) 797 - 0909

ANALYSIS OF ANCHORED HI-STORM CASKS AT THE DIABLO CANYON ISFSI

FOR

PG&E

Holtec Report No: HI-2012618

Holtec Project No: 1073

Report Class : SAFETY RELATED

NON PROPRIETARY VERSION

DOCUMENT NAME: Seismic Analysis of Anchored HI-STORM 100 Casks at Diablo Canyon ISFSI

DOCUMENT NO.:	2012618	CATEGORY: ☐	GENERIC
PROJECT NO.:	1073	X	PROJECT SPECIFIC

Rev. No.[2]	Date Approved	Author's Initials	VIR #	Rev. No.	Date Approved	Author's Initials	VIR #
0	3/5/01	AIS	50049	3	6/19/01	AIS	165327
1	3/5/01	AIS	211334	4	11/6/01	AIS	832701
2	5/11/01	AIS	388872	5	12/11/01	AIS	51938

DOCUMENT CATEGORIZATION

In accordance with the Holtec Quality Assurance Manual and associated Holtec Quality Procedures (HQPs), this document is categorized as a:

X Calculation Package[3] (Per HQP 3.2)

☐ Technical Report (Per HQP 3.2) (Such as a Licensing Report)

Design Criterion Document (Per HQP 3.4)

☐ Design Specification (Per HQP 3.4)

☐ Other (Specify):

DOCUMENT FORMATTING

The formatting of the contents of this document is in accordance with the instructions of HQP 3.2 or 3.4 except as noted below:

DECLARATION OF PROPRIETARY STATUS

This document is labeled:

X Nonproprietary ☐ Holtec Proprietary ☐ TOP SECRET

Documents labeled TOP SECRET contain extremely valuable intellectual/commercial property of Holtec International. They cannot be released to external organizations or entities without explicit approval of a company corporate officer. The recipient of Holtec's proprietary or Top Secret document bears full and undivided responsibility to safeguard it against loss or duplication.

Notes

1. This document has been subjected to review, verification and approval process set forth in the Holtec Quality Assurance Procedures Manual. Password controlled signatures of Holtec personnel who participated in the preparation, review, and QA validation of this document are saved in the N-drive of the company's network. The Validation Identifier Record (VIR) number is a random number that is generated by the computer after the specific revision of this document has undergone the required review and approval process, and the appropriate Holtec personnel have recorded their password-controlled electronic concurrence to the document.

2. A revision to this document will be ordered by the Project Manager and carried out if any of its contents is materially affected during evolution of this project. The determination as to the need for revision will be made by the Project Manager with input from others, as deemed necessary by him.

3. Revisions to Calculation Packages may be made by adding supplements to the document and replacing the "Table of Contents", and the 'Revision Log".

HOLTEC SAFETY SIGNIFICANT DOCUMENTS

In order to gain acceptance as a *safety significant* document in the company's quality assurance system, this document is required to undergo a prescribed review and concurrence process that requires the preparer and reviewer(s) of the document to answer a long list of questions crafted to ensure that the document has been purged of all errors of any material significance. A record of the review and verification activities is maintained in electronic form within the company's network to enable future retrieval and recapitulation of the programmatic acceptance process leading to the acceptance and release of this document under the company's QA system. Among the numerous requirements that this document must fulfill, as applicable, to muster approval within the company's QA program are:

- The preparer(s) and reviewer(s) are technically qualified to perform their activities per the applicable Holtec Quality Procedure (HQP).
- The input information utilized in the work effort is drawn from referencable sources. Any assumed input data is so identified.
- All significant assumptions are stated.
- The analysis methodology is consistent with the physics of the problem.
- Any computer code and its specific versions used in the work have been formally admitted for use within the company's QA system.
- The format and content of the document is in accordance with the applicable Holtec quality procedure.
- The material content of the report is understandable to a reader with the requisite academic training and experience in the underlying technical disciplines.

Once a safety significant document, such as this report, completes its review and certification cycle, it should be free of any materially significant error and should not require a revision unless its scope of treatment needs to be altered. Except for regulatory interface documents (i.e., those that are submitted to the NRC in support of a license amendment and request), editorial revisions to Holtec *safety significant* documents are not made unless such editorial changes are deemed necessary by the Holtec Project Manager to prevent erroneous conclusions from being inferred by the reader. In other words, the focus in the preparation of this document is to ensure correctness of the technical content rather than the cosmetics of presentation".

REVISION LOG

Revision 0 – Original issue.

Revision 1 – Revised in accordance with client comments. Analyses completely redone with seismic input applied at base of slab (instead of top of embedment). Preloaded anchor studs removed from analyses by using different free body and replaced by long anchor rods that tie the embed plate to the concrete. These are not preloaded. All seismic analyses redone using specification damping values at the base of the embed plate (concrete) and the long rods (steel), and results are filtered at 40 Hz. The analyses of the preload between cask and embed plate is performed as a separate item where it is demonstrated that the preload is sufficient under the computed forces from the dynamic analyses of the long anchor rods. Also, editorial comments are incorporated.

Revision 2 – Addressed technical comments from client. New calculations added to demonstrate that the effect of initial loading of the embedment anchor rods is small and the dynamic results remain valid. Revised model (gusset locations) for the calculation of the sector lug stress to resolve comments and reduce the stress. Added additional figures describing stress state in sector lugs. Revised and expanded weld calculations. Appendix A calculations revised based on class 2A threads and final compression block geometry.

Revision 3 – Editorial comments from client incorporated in this revision. PE stamp added. Technical review comments from independent alternate calculations were not incorporated since they confirmed conservative safety factors.

Revision 4 – Text information added after Table 3 (per request of client e-mail, 10/20/01) discussing effect of scale factors (on time histories required to meet SRP 3.71) on calculated results. Ref. 11.14 added since it is noted in added information.

Revision 5 – Corrected free-length of stud calculation in Appendix A. This required that some self-contained calculations in main text be altered to conform with new results in

Appendix A. However, these changes did not alter any of the VN simulations nor their results. The text calculations were updated (stud fatigue, the calculation of incremental stud loads), and the nomenclature in a sketch in the text was updated to clarify the simulation model. This version is PE stamped.

"The revision status of Holtec documents is subject to updates as the project progresses. This document will be revised if a revision to any of the above-referenced Holtec work products materially affects the instructions, results, conclusions or analyses contained in this document. Otherwise, a revision to this document will not be made and the latest revision of the referenced Holtec documents shall be assumed to supersede the revision numbers cited above. The Holtec Project Manager bears the undivided responsibility to ensure that there is no intra-document conflict with respect to the information contained in all Holtec generated documents on a safety significant project".

PREFACE

This Calculation Package has been prepared pursuant to the provisions of Holtec Quality Procedures HQP 3.0 and 3.2, which require that all analyses utilized in support of the design of a safety-related or important-to-safety structure, component, or system be fully documented such that the analyses can be reproduced at *any time in the future* by a specialist trained in the discipline(s) involved. HQP 3.2 sets down a rigid format structure for the content and organization of Calculation Packages that are intended to create a document that is complete in terms of the exhaustiveness of content. The Calculation Packages, however, lack the narration smoothness of a Technical Report, and are not intended to serve as a Technical Report.

Because of the Calculation Package's function as a repository of all analyses performed on the subject of its scope, this document is typically revised only if an error is discovered in the computations or the equipment design is modified. Additional analyses in the future will be added as numbered supplements to this Package. Each time a supplement is added or the existing material is revised, the revision status of this Package is advanced to the next number and the Table of Contents is amended.

EXECUTIVE SUMMARY

The HI-STORM 100SA storage overpack, containing a loaded MPC, is anchored to the Diablo Canyon ISFSI steel embedment by pre-tensioned anchor studs grounded to appropriately designed embedment steelwork. This preload generates a large compressive interface force between the base of the cask and the top surface of the steel embedment plate. The embedment plate structure is held to the slab by long anchor rods that are not preloaded and attached to the bottom surface of the embedment plate. The bottom of the embed plate is grounded on concrete but no compression other than the total vertical load from the cask system is assumed to act. The storage system can be subject to a seismic event that causes forces and moments to be transferred to the embedment and from the embedment to the slab through the anchor rods and compression at the embed plate-concrete interface (the lower surface of the embed plate). The design basis seismic excitations are designated as:

DE – Design Earthquake
DDE – Double Design Earthquake
HE – Hosgri Earthquake
LTSP – Long Term Seismic Program Earthquake

Each of these seismic events is characterized by free-field acceleration-time histories, in each of three orthogonal directions. The DE and DDE have 41 sec. event duration, while the HE and the LTSP have 48 sec. duration. Only the LTSP and the HE events are utilized as these events have the largest zero period accelerations (ZPA) and provide the bounding results for a Part 72 evaluation. To ensure that the most bounding solution is obtained, simulations are also performed with the direction of the vertical excitation reversed.

The objectives of the simulations are two-fold:

To demonstrate that the seismic events do not induce acceleration levels that exceed the cask design basis (per the FSAR) and do not induce a state of stress in the preloaded anchor studs that connect the cask to the embed plate that exceeds the design basis ASME Code limits.

To establish the interface loads transferred to the ISFSI pad embedment. These interface loads provide the design input for an evaluation of the structural integrity of the ISFSI pad and the anchor rods that maintain the interface between the lower surface of the embedment plate and the concrete slab.

The results from the series of evaluations performed in this report are summarized below:

The anchored casks do not develop body decelerations that exceed the cask design basis of 45 g's [11.4,Table 3.1.2, and 3.1.3 including footnotes]. This ensures the integrity of the fuel basket and ready retrievability of the fuel where both lateral and longitudinal "g" loadings must be considered.

The state of stress in the pre-tensioned cask anchor studs and in the cask flange and shell meet the stress limits of the ASME Code Section III, Subsection NF and Appendix F.

The interface loads at the lower surface of the embed plate are summarized in tabular form. The values are obtained from the time histories that result from the dynamic simulations. These time history results are filtered (to remove higher frequency (above 40Hz) peak values) prior to reporting the peak results in the table.

SEISMIC EVENT AT ISFSI	HE	LTSP	HE**	LTSP**
Maximum/Minimum Interface Compression Force (kips)***	674.2/127.6	684.1/105.8	773.3/130.6	632.0/55.6
Maximum Interface Shear Force Along X axis (kips) *	509.4	432.0	379.9	325.8
Maximum Interface Shear Force Along Y axis (kips)*	460.5	355.5	426.1	364.6
Maximum Net Interface Shear Force (kips)	515.0	440.0	428.0	390.0
Maximum Interface Moment About X Axis at Interface (kip-in.)	54,564	42,139.2	50,498	43,209
Maximum Interface Moment About Y Axis at Interface (kip-in.)	60,369	51,197.2	45,017	38,603
Maximum Net Interface Moment (kip-in)	61,000	52,000	50,500	46,000
Effective COF at Cask/Embedment Interface	0.180	0.154	0.150	0.132
Maximum Tensile Load in Embedment Anchor Rods (kip)	62.13	48.85	49.73	42.34

* Base Maximum Shear forces are computed by dividing the appropriate maximum moment by the height to the centroid (118.5 inch). Y-Shear goes with MX, X-Shear goes with MY.
** These simulations have the vertical excitation reversed in direction over the total event time.
*** Includes dead load = 360,000 lb.

The moments and forces reported above act at the lower surface of the embed plate. The X, Y, Z axes are located at a point on the cask longitudinal centerline (extended to the bottom surface of the embed plate). The X, Y directions correspond to the East-West and North-South directions, respectively, and the Z-axis is vertically upward.

Subsequent to the anchored cask analyses, it was determined that the Hosgri seismic event at 7% damping required scaling-up by 7% [Reference 11.14] in order to meet SRP 3.7.1 spectral matching criteria; the Hosgri time histories for 4% & 5% damping, however, need no scaling [Reference 11.14] to conform to SRP 3.7.1 spectral matching requirements. The LTSP seismic event, which does not provide bounding loads for the pad design, needs scaling at 5% [Reference 11.14] in order to completely satisfy SRP criteria. We note, however, that the LTSP does not provide the bounding inputs for the pad design; this remains true even if the results for the LTSP input are scaled up by 5%. If we therefore limit discussion to the bounding HE, in order for the results reported in Table 3; to be completely in conformance to the regulations, no more than 5% damping should be associated with the cask/concrete compression interface (the reported results are based on 4% steel/ 7% concrete damping for the Hosgri event per Appendix A). It is our considered opinion, based on engineering judgment, that the effect of a decrease in the damping at this location (all other damping values are at 4%) would lead primarily to additional amplifications only for high frequency contributions. Since the results of interest for pad design are filtered to remove components above 40 Hz, we expect that a damping reduction at the concrete/cask interface will have negligible effect on the results.

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1.0 INTRODUCTION AND SCOPE

The ISFSI at Diablo Canyon is designated as a high seismic site as some of the site-specific seismic inputs are too large to ensure stability of a freestanding storage cask. To safely store spent nuclear fuel in a HI-STORM 100 at such a site, special provisions for anchoring the cask to the ISFSI pad are added to the cask, and the anchorage must be designed and analyzed to demonstrate compliance with the appropriate design code. Herein, we provide the calculation details that support the structural qualification of the HI-STORM 100SA (the "A" designating a cask with added anchoring features and the "S" designating a low profile cask) at the Diablo Canyon ISFSI site.

The anchored HI-STORM sits on a steel embedment plate having a diameter in excess of the outer diameter of the HI-STORM baseplate. The HI-STORM is anchored to the steel embedment plate using pre-tensioned anchor studs threaded into compression blocks to ensure a continuous compressive state of stress at the interface between the cask and the embedment plate. The embedment plate is held to the concrete by longer anchor rods that are not initially pretensioned but are loaded as the seismic event proceeds to the extent necessary to maintain force and moment equilibrium. . Figure 1 shows a section of the anchored cask connection to the ISFSI. The cask flange is held in contact with the embedment plate by a series of pre-tensioned anchor studs. The studs are threaded into a "compression block" that serves to induce a high compressive state of stress at the steel-steel interfaces #1 and #2 in Figure 1. The entire embedment (plate plus compression blocks) is fixed to the concrete by a set of long cask anchor rods that are not pre-tensioned. Figure 1 shows the compression block hole as a threaded hole through the block thickness. In reality, the thread starting location, relative to interface #2, is set to ensure the proper free-length of the pre-tensioned anchor stud. The nomenclature introduced in Figure 1 is used throughout this report.

The scope of this analysis includes qualification of the pre-tensioned anchor studs that attach the cask to the steel embedment plate at the top surface of the ISFSI slab, structural qualification of the support structure (cask sector lugs), and the determination of interface loads at the base of the embedment plate transmitted to the ISFSI pad and to the embedment plate anchor rods. The embedment plate design and qualification, the qualification of the embedment anchor rods, and the structural analysis of the ISFSI pad utilize these interface loads as design basis input

2.0 METHODOLOGY

The objectives of the seismic analyses are the following:

i. Quantify the structural safety factor in the pre-tensioned anchor studs connecting the cask to the upper surface of the embedment plate, and in the cask sector lugs that constitute the fastening system for the loaded HI-STORM 100SA overpack. The structural safety factor is defined as the ratio of the permitted stress (stress intensity) per Subsection "NF" of the ASME Code to the maximum stress (stress intensity) developed in the loaded component.

ii. Demonstrate that fatigue failure of the pre-tensioned anchor studs and sector lugs from a single seismic event is not credible.

iii. Quantify the interface loads at the interface of the lower surface of the embedment plate to the ISFSI pad to enable the ISFSI owner to design and analyze the embedment plate, the ISFSI pad, and the embedment plate anchor rods and shear resisting structure that fix the embedment plate to the concrete pad.

The above design objectives are satisfied by performing dynamic analyses of a loaded HI-STORM 100SA plus the embedment plate that is considered to be bearing on the slab and held to the slab by a set of long anchor rods. The dynamic analyses employ a three-dimensional model that incorporates contact impacts between the overpack and MPC, and simulation of the anchoring system (bearing loads on the concrete and tensile loads in the anchor rods).

The key design concept for the anchored HI-STORM 100A storage system is to extend the baseplate of the overpack to form a flange. This flange permits "mating" of the overpack to the ISFSI pad steel embedment by preloaded cask anchor studs. The preloaded cask anchor studs ensure that interface contact is maintained between the ISFSI pad embedment upper surface and the lower surface of the HI-STORM baseplate. This continued contact allows for development of interface friction forces to preclude significant lateral movement of the base relative to the ISFSI pad and also ensures that the ISFSI pad embedment provides the majority of the resisting moment to stabilize the system under the large seismic forces.

3.0 ACCEPTANCE CRITERIA

The design criteria for the HI-STORM 100 Storage System (the anchored system at the Diablo Canyon ISFSI is designated as HI-STORM 100SA) are compiled in the FSAR in Chapter 2.0. As the anchorage system for the HI-STORM 100SA is an integral part of the cask, the anchorage system has the same design requirements imposed.

The anchorage (cask anchor studs and sector lugs) is designed to the static stress limits of the ASME Code, Section III, Subsection NF [11.6] and Appendix F [11.7]. Two conditions are defined:

Level A (Preload) – The cask anchor stud preload is established at approximately 157 kips in each stud. Under this load and the corresponding balancing load from the ISFSI, the sector lug structural components must meet the allowable stress limits for plate and shell structures given in NF-3200 of [11.6]. Table 3.1.10 in [11.4] provides the stress limits for SA-516 Grade 70 material at 200 degrees F (a conservatively high temperature).

Level D (Preload + Seismic Load) – Per Appendix F of [11.7], the tensile stress in the stud averaged through the cross-section is limited to 70% of the ultimate strength of the stud material. The extreme fiber stress in the stud is limited to the ultimate strength per F-1335.1. The stress intensity limits for the sector lug components are given in Table 3.1.12 [11.4] in accordance with the design criteria set forth in Section 4.2 of [11.2].

The cask anchor stud alternating stress intensity, under the dynamic loading from one design basis seismic event, must be sufficiently low so that a safety factor > 1.0 against a cask anchor stud fatigue failure is demonstrated for the number of stress intensity cycles associated with the seismic event.

4.0 ASSUMPTIONS

In the dynamic analyses, the HI-STORM 100SA overpack and the internal loaded MPC are modeled as separate rigid bodies. This is consistent with the response frequencies associated with the event and with the lowest elastic frequencies associated with the bodies.

In the dynamic analysis, the overpack and the embedment plate are assumed to move as a single body. This is a realistic assumption since the preload existing at interface #1 (Figure 1) serves to minimize relative movement.

In the dynamic analyses, the contact between the MPC and the overpack is simulated by a classical impulse-momentum equation. The coefficient of restitution (COR) is set to 0.0 reflecting the large contact areas involved and the coefficient of friction is set to 0.5, which is representative of steel-on-steel. The choice of coefficient of restitution is realistic and allows for energy loss during contact between the two large rigid bodies. The coefficient of friction involved in MPC-to overpack contacts plays little role in the dynamic analyses since the contacts are primarily normal impacts.

In the dynamic simulations, the interface contact between the base of the embedment and the ISFSI concrete is modeled by discrete linear springs to simulate the embedment anchor rods and by compression-only elements to simulate the balancing force from the concrete under the embedment. The spring rates are computed using a specified effective free length for the embedment anchor components and damping consistent with the Diablo Canyon Specification for steel and concrete components. These are realistic assumptions that appropriately model the expected interface behavior.

In the dynamic model, bounding (high) weights are used for conservative results; inertia properties are computed consistent with these bounding weights.

In the post-processing of the results from the dynamic analysis, filtering is employed to remove high frequency peaks in the solutions that arise due to the large stiffness values that are multiplied by small displacements to achieve a numerical result (i.e. for stud incremental force). To capture all of the energy of the seismic event, the filtering frequency is set as 40 Hz. Structural qualification of the cask anchor studs and the cask sector lugs is based on the peak filtered loads. The use of filtering of dynamic results in cask structural integrity analysis has been previously used in the HI-STAR SAR (impact limiter performance), FSAR (drop and tipover analysis), and in the HI-STORM FSAR [11.4, Appendix 3.A].

5.0 INPUT DATA

The bounding weights for the loaded HI-STORM 100A and for the MPC are used in the analysis. Table 3.2.1 of [11.4] lists these bounding weights as:

HI-STORM 100A – 270,000 lb. (empty)
MPC - 90,000 lb.

SA193-B7 has been chosen by the ISFSI owner as a suitable cask anchor stud material. For the dynamic simulation, the following properties are used: [11.5]

Anchor Stud Minimum Yield Strength – 105 ksi
Anchor Stud Minimum Ultimate Strength - 125 ksi

The dimensions for the two bodies are obtained from relevant drawings in Section 1.5 of [11.4,11.11]. Mass moment of inertia properties are computed based on cylindrical body assumptions with the specified mass assumed to be uniformly distributed.

The free-field seismic inputs for the dynamic analyses are obtained from acceleration time histories developed from appropriate response spectra and have been provided to Holtec. Figures 2-4 provide the acceleration vs. time inputs for the LTSP, the HE, and the DDE events, respectively. The DDE time histories are obtained from the DE event by multiplying by 2.0. The maximum amplitudes of the acceleration time histories, in each of three directions, represent the Zero Period Acceleration (ZPA) values. The following values are obtained from a scan of the supplied time histories:

	LTSP	HE	DDE	DE
Time History #1(horizontal E-W)	0.885	0.766	0.401	0.2
Time History #2(horizontal N-S)	0.83	0.816	0.404	0.202
Time History #3(vertical)	0.725	0.547	0.27	0.135

Detailed dynamic simulations are performed herein only for the LTSP and the HE events as these events impart the highest loading to the anchorage components.

The following table summarizes the design inputs used for the analyses with the actual values used at the Diablo Canyon ISFSI:

TABLE 1

INPUT DATA FOR SEISMIC ANALYSIS MODEL OF ANCHORED HI-STORM 100 SYSTEM

Item	Data Used	Actual Value for DC ISFSI
Cask height, inch	231.25	215" (Dwg. 1495 of [11.4])
Contact diameter at ISFSI pad, inch	146.5	146.5 (Dwg. 3187 of [11.4])
Overpack empty, wt. Kips	270	267.87 (Table 3.2.1 of [11.4])
Bounding wt. of loaded MPC, kips	90	88.135 (Table 3.2.1 of [11.4])
Overpack-to-MPC radial gap (inch)	0.63	0.63 (Dwg. 1495, [11.4])
Overpack C.G. height above ISFSI pad, inch	117.0	116.8 (Table 3.2.3 of [11.4])
Overpack with Loaded MPC - C.G. above ISFSI pad (inch)	118.5	118.5 (Table 3.2.3 [11.4])
Applicable Seismic Inputs	Figs. 2-3	Figs. 2-4
No. of Anchor Studs	16	16
Anchor Stud Diameter (inch); Yield stress, ksi; Ultimate stress, ksi; Pre-load tensile stress, ksi	2.0; 105; 125; 62.8	2.0; 105; 125; 55-65
Interface Coefficient of Friction	0.25	0.25 (minimum per ASME NF, NF-3324.6)
Cask Anchor Stud Spring Rate, kips/inch	10,380	10,380
Cask/Embedment Compression Contact Spring Rate, kips/inch per stud	65,880	58,660
Embedment Anchor Rod Spring Rate, kips/inch	1,898	1,898
Embedment/concrete Compression Contact Spring Rate, kips/inch per contact point	25,250	25,250
Effective Damping at ISFSI interface (assumed)	4% steel; 7% concrete for HE 5% steel; 5% concrete LTSP	Per Specification [11.1]
Coefficient of Restitution for HI-STORM/MPC Impacts (assumed)	0.0	NA

The cask anchor stud locations are provided in tabular form below. The locations are referenced to a coordinate system grounded at the center of the circular contact patch at the interface between the base of the cask and the top surface of the embedment. The local Z-axis of this coordinate system is vertically upward. The embedment anchor rods have the same X-Y coordinate locations. The sector lug geometry is detailed in Holtec Drawing 3570, Rev. 0.

The following identifiers and X, Y coordinates locate the linear springs representing the 16 pre-tensioned cask anchor studs around the cask anchor stud circle. These coordinates also are the locators for the embedment anchor rods that tie the embedment plate to the concrete. For the purpose of simplifying data input, these locations are determined by dividing the stud circle into thirty-two equal angular segments and identifying 16 locations for the actual studs and rods. These locations differ slightly from the locations identified on the cask drawings since the location and width of the air inlet ducts are not included in the model. These minor geometry differences have insignificant effect on the numerical results and conclusions.

Spring Number	X(inch)	Y(inch)
16	13.61	68.41
18	38.75	57.99
20	57.99	38.75
8	-38.75	-57.99
1	68.41	-13.61
10	-57.99	-38.75
11	-68.41	13.61
13	-57.99	38.75
15	-38.75	57.99
3	57.99	-38.75
5	38.75	-57.99
6	-13.61	-68.41
22	13.61	-68.41
24	-68.41	-13.61
26	-13.61	68.41
28	68.41	13.61

The coordinates are defined in a X-Y system with X (east) and Y (north) and the center of the axes set located at the center of the stud circle. For example, studs 28, 20, 18, and 16 lie in the northeast quadrant. Figure 5 pictorially locates the studs and rods around the stud circle periphery.

In the dynamic simulation model, each embedment anchor rod is simulated by a linear spring with a force-deformation relation of the form:

$$F = -k\delta - c\dot{\delta}$$

where k, c are the spring constant and the damping coefficient (see Appendix A), and δ is the local spring extension. The resistance of the concrete against the lower surface of the embedment is simulated by a custom contact model in VN where each facet is assigned a force-deformation relation similar to that for the embedment anchor rods, but with appropriate spring constant and damping coefficient as computed in Appendix A. Subsection 7.2 contains a sketch with a typical anchor rod and compression element representation.

6.0 COMPUTER CODES

The main section of this report is written using Microsoft Word (Office 2000), while the calculation appendices are prepared using MathCad (Version 2000 unless otherwise noted below), or are also written in MS Word and contain manual calculations and/or finite element results.

The following CAD and analysis codes have been used in the analyses:

CAD program – Solidworks 2000, Solidworks, Inc.
VisualNastran 2001, MSC Corporation
ANSYS 5.6, ANSYS, Inc.
Matlab 5.2, Mathworks, Inc, 1997.

Both VisualNastran 2001 (formerly known as Working Model 4-D) and ANSYS have been independently validated in accordance with Holtec QA requirements. The CAD program is an established commercial CAD program used by Holtec for design and drafting tasks. Matlab is an established commercial code that is used herein to perform filtering of the results from VisualNastran. Matlab has been previously employed for calculations in support of the HI-STAR SAR Part 71 submittal. It is a widely accepted program with usages comparable to Mathcad and Excel.

7.0 ANALYSES

The objectives of the dynamic seismic analyses are the following:

i. Quantify the structural safety factor in the cask anchor studs and in the sector lugs that constitute the fastening system for the loaded HI-STORM 100A overpack. The structural safety factor is defined as the ratio of the permitted stress (stress intensity) per Subsection "NF" of the ASME Code to the maximum stress (stress intensity) developed in the loaded component.

ii. Compute the safety factor against fatigue failure of the cask anchor studs from a single seismic event.

iii. Quantify the interface loads applicable to the ISFSI pad to enable the ISFSI owner to design the ISFSI pad.

7.1 Static Analyses

Finite element analyses of the sector lugs, subject to preload and to a representative Level D load set, are performed to structurally qualify the sector lugs. Figure 8 shows the finite element mesh and the extent of the model. The stud hole in the lower annular ring (the extension of the overpack base plate) is not modeled; rather, the stud load is assumed as uniformly distributed over the area of the stud washer (not modeled) and the stiffening effect of the washer conservatively neglected. The results from the finite element analysis are described in Subsection 9.1 below. A bounding stud load is used and it is conservatively assumed that there is local separation under the sector lug during a seismic event.

7.2 Dynamic Analyses

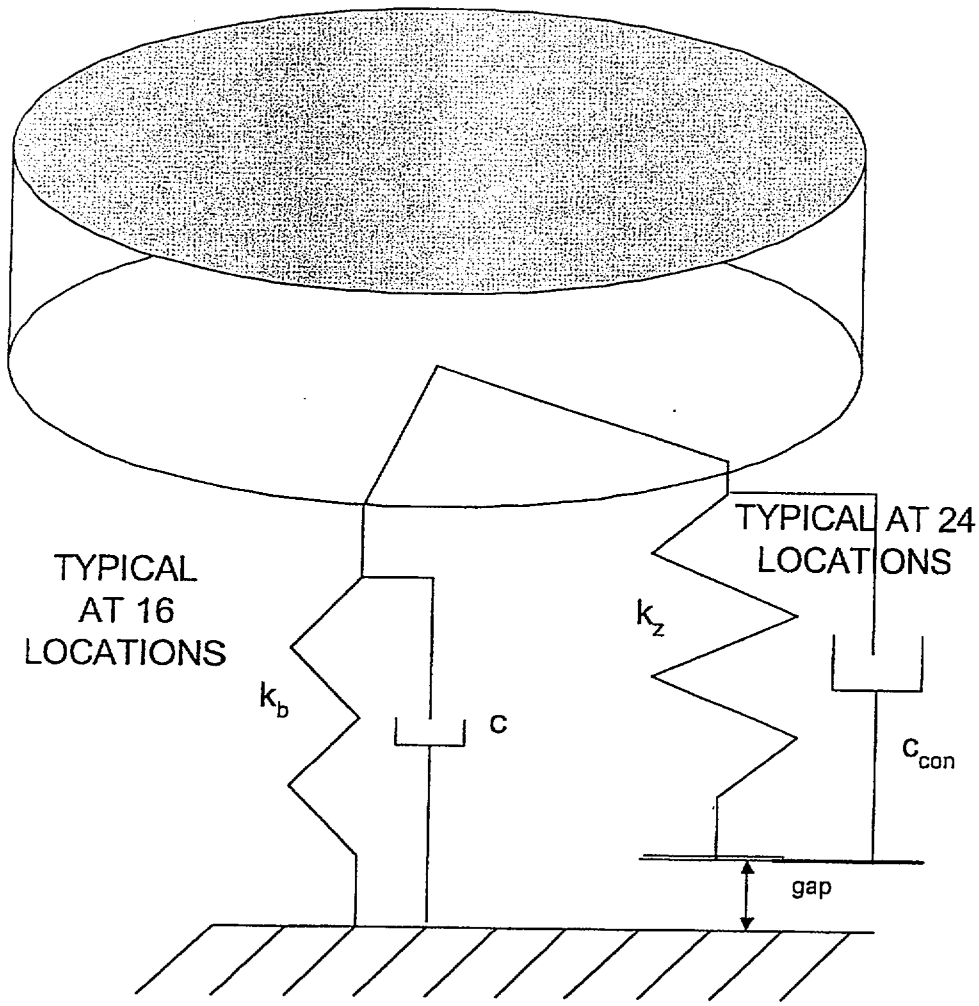
The dynamic model of the HI-STORM 100SA System consists of the following major components.

i. The HI-STORM 100 overpack, together with the underlying embedment plate is modeled as a six degree-of-freedom (rigid body) component. The initially pre-tensioned cask anchor studs are assumed to maintain cask base and embedment plate interface contact.

ii. The loaded MPC is also modeled as a six degree-of-freedom (rigid body) component that is free to rattle inside the overpack shell. Gaps between the two bodies reflect the nominal dimensions from the drawings.

iii. The contact between the MPC and the overpack is characterized by a coefficient of restitution and a coefficient of friction. For the dynamic analysis, the coefficient of restitution is set to 0.0, reflecting the large areas of nearly flat surface that come into contact and have minimal relative rebound. The coefficient of friction is set to 0.5 between all potentially contacting surfaces of the MPC/overpack interface. The value employed for coefficient of friction is not critical since the internal impacts are essentially normal impacts.

iv. The embedment anchor rods, initially under zero tensile load, together with compression between the embedment plate lower surface and the ISFSI slab, provide the vertical connection between the embedment plate and the ISFSI slab. The embedment anchor rods are modeled as individual linear springs connecting the periphery of the embedment plate to the ISFSI pad section. As shown in Figure 1, the location of the embedment anchor rods mirrors the location of the cask anchor studs; the compression blocks shown in Figure 1 serve as the load transmission vehicle between the embedment anchor rod tension that arises from seismic loading and incremental changes in the cask anchor studs and the interface compression loads (at interfaces 1 and 2 in Figure 1). The resistance at the embedment/ISFSI pad concrete foundation is simulated by compression-only elements. The spring rates for the embedment anchor rods and for the compression-only contact elements are developed in Appendix A. Appropriate structural damping is assigned using the appropriate percent of critical damping specified in [11.1]. Appendix A contains the calculation details to support the dynamic analyses model and the spring rates reported in Table 1 in Section 5 of this report. Appropriate shear resistance is imposed on the model to ensure that the embedment plate does not move laterally during the seismic event. A sketch of the interface modeling details is provided below:



SKETCH SHOWING DETAILS AT INTERFACE (Nomenclature per Appendix A)

v. The ISFSI pad is driven with the three components of acceleration time-history applied simultaneously. Figures 2-4 provide the three components of excitation for the LTSP, HE, and DDE, respectively. The DE seismic time histories are 50% of the DDE events. It is clear that the response from the LTSP and HE events provide the bounding loads to the anchorage; therefore, detailed results are presented only for these events. To evaluate the importance of directional effects on the responses, both the LTSP and the HE simulations are run twice with the only change being the negative of the vertical seismic time history is used in conjunction with the specified horizontal time histories.

vi. The initial preload applied to the cask anchor stud is assumed to be fully reacted at the compression interface and that any tensile load induced in the embedment anchor rods during the preload will be lost since the concrete will undergo creep. This is a simplifying assumption that is justified in the analysis section of this report.

The HI-STORM 100SA dynamic model described above is implemented on the public domain computer code VisualNastran (formerly known as Working Model) (See Subsection 3.6.2 of [11.4] for a description of the algorithm).

Figures 6 and 7 show the rigid body components of the dynamic model before and after assembly. The linear springs are not shown. Mass and inertia properties of the rigid bodies are consistent with the bounding property values in Table 1.

Dynamic analyses are performed using the design basis LTSP and HE acceleration time histories and then rerun with the vertical input direction reversed. Results from the analyses are summarized in Subsection 9.2. The post-processing requirements are discussed below:

The VisualNastran (VN) dynamic analyses produce time history results for the tensile loads in each of N embedment anchor rods, and time history results for the total interface compression load between the base of the embedment and the ISFSI concrete. The total interface compressive load reflects any local separation by evaluating the local separation at each facet point evaluated for contact, but there is no reporting of the offset of the total compressive load; hence, the effect of the resultant moment of the compressive load cannot be directly determined from a VN "meter". The results of the VN time history analyses are stored in Excel spreadsheet form and a separate computer code developed to post-process the results for the anchor rod tensions and the local compressions around the periphery so as to determine vertical load and overturning moment time histories for the embedment analysis. Appendix C contains the Fortran code written to develop the desired results. The Fortran code has been validated specifically for this application by comparison with manual calculations. In what follows, a description of the post-processing of the seismic results is presented:

The inputs to the post-processor are from the VN seismic analysis; specifically,

Time history results for N embedment anchor rod tensile loads

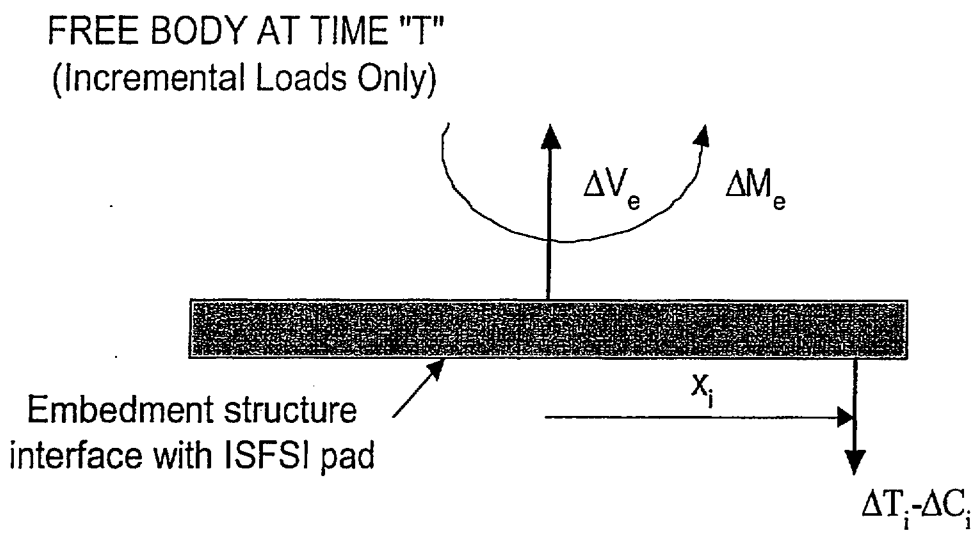
Time history results for net compressive load at the embedment plate/ISFSI concrete interface (i.e., the sum of all compression loads at the interface compression element locations)

K_B, K_F, the embedment anchor rod and foundation spring rates

The following quantities are defined:

W	=	dead weight of loaded HI-STORM 100 SA
ΔT_i	=	incremental tensile load in i^{th} embedment anchor rod
ΔC_i	=	incremental compressive load on embed plate at each embedment anchor rod location
X_i Y_i	=	x, y coordinates of i^{th} embedment rod centerline
ΔV	=	incremental net load (vertical) on embedment plate lower surface
ΔM	=	incremental net bending moment on embedment plate lower surface
N	=	number of cask anchor studs (and embedment anchor rods)
C	=	Current compression – dead weight applied to embedment = $\Sigma \Delta C_i$

The configuration shown below represents the cask and the embedment plate. The applied loading at the plate/concrete interface is a vertical force $W+\Delta V_e$ and an overturning moment ΔM_e. The vertical force is made up of dead weight plus any incremental vertical reactions from seismic loading. The incremental overturning moment arises only from seismic loading. These net forces and moments are balanced by the tensile loads in the embedment anchor rods and the interface compression loads that are calculated from the dynamic simulation. The free body below shows the incremental loads from the anchor rods and the interface compression balancing the applied seismic loading. The vertical reaction balancing the dead weight is not shown. The assemblage of rod tensions and interface compression loads around the periphery are equivalent to, and can be replaced by, a net incremental load and a net incremental moment. We now seek to determine the incremental load and moment ΔV and ΔM as it is more convenient to describe the interface loads in terms of net force and moment rather than individual anchor rod loads and compression interface loads.



Under the seismic action, the external incremental loads cause increments ΔT_i and ΔC_i to develop around the periphery of the embedment anchor rod circle, and an overturning moment develops since these incremental anchor rod and interface compression loads that react the applied load vary around the periphery. Since the "stretch" of the embedment anchor rod is equal to the "compression" of the local interface, as long as there is no interface separation, the following relation between the incremental embedment anchor rod tension and the incremental embedment/ISFSI pad interface compression holds:

$$\frac{\Delta T_i}{K_B} = -\frac{\Delta C_i}{K_F} \quad (1)$$

Replacing the contributions from the individual tension and compression elements with the net force and moment gives the equations:

$$\Delta V = \Sigma \Delta C_i - \Sigma \Delta \mathrm{T}_i \quad (2)$$

The above equation defines the incremental vertical load.

Noting that $\Sigma\Delta C_i = C$, the change in vertical load is

$$\Delta V = C - \Sigma \Delta \mathrm{T}_i \quad (3)$$

Similarly, the resultant moment is defined by the contributions from the individual elements and produces the defining relation:

$$\Delta M = \Sigma(\Delta \mathrm{T}_i - \Delta C_i) X_i \quad (4)$$

Using equation (1), when there is no separation at any stud location, gives the result:

$$\Delta M = \Sigma X_i \left(1 + \frac{K_F}{K_B}\right) \Delta \mathrm{T}_i \quad (5)$$

The above relation holds as long as there is no separation under the embedment anchor rod at the interface. Since embedment anchor rod preload is removed by concrete creep, the initial compression at the interface, at the start of a seismic event, is simply the total cask weight divided by the total compression stiffness at the interface. Define this initial compression as "Do" so that

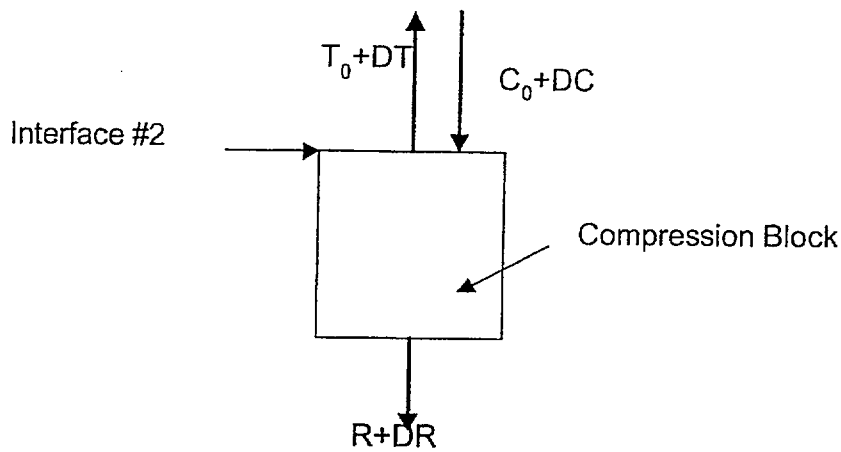
$$Do = W/(K_F) \quad (6)$$

Local separation is evaluated by comparing Do with the computed extension of the anchor rod "Dr", where

$$Dr = \Delta T/(K_B) \quad (7)$$

If Dr > Do, then there is local separation and the total change in compression at the local interface is limited to K_F x Do at that instant of time.

The above relationships have been incorporated into a post-processing computer code (see Appendix C). With the time history of the ensemble of embedment anchor rods established, the maximum tension load in the embedment anchor rods can be established and an evaluation of the effect of the preload and the embedment anchor rod loads on the state of loading at the interface between the compression block and the embedment plate and between the embedment plate and the cask sector lug flange. Consider a free-body of the compression block associated with the embedment anchor rod having the maximum tensile load over the seismic event duration. Define this maximum tension as "R". At the instant of time when the maximum tension occurs, equilibrium of the compression block (see Figure 1), the preloaded cask anchor stud and the local interface compression load together provide force equilibrium. We neglect the small amount of compression that may exist at the block/concrete interface. Define T_0 as the initial cask anchor stud preload and C_0 as the corresponding interface local compression load. The values associated with these initial loading are assumed to be the values after any initial tensile loads in the embedment anchor have relaxed due to creep of the ISFSI concrete. The change in these loads necessary to ensure compression block force equilibrium is designated as DT and DC, respectively. Therefore, the free-body of the compression block is (neglect small contribution from compressive loads at the embedment/concrete interface) under a change in anchor rod tension DR is:



From the analysis in Appendix A associated with the cask/embedment connection (interfaces 1 and 2 in Figure 1), spring rates for the cask anchor studs and for the interface compression resistance have been computed. Identify these spring rates as "K_{b1}" and "k_{eff1}", respectively (consistent with the nomenclature in Appendix A) and note that compatibility of displacements at the interface requires that

$$\frac{DT}{K_{b1}} = -\frac{DC}{k_{eff1}} \qquad (8)$$

Therefore, the embedment anchor rod tensile force change "DR" is accommodated by changes in cask anchor stud tension "DT" and local interface compression, "DC" as follows:

$$DT = \left(\frac{K_{b1}}{k_{eff1} + K_{b1}}\right)DR \qquad DC = \left(-\frac{k_{eff1}}{k_{eff1} + K_{b1}}\right)DR \qquad (9)$$

Since $k_{eff1} > K_{b1}$ (see calculation in Appendix A), it is clear that the embedment anchor rod tensile loads are primarily accommodated by a decrease in the compression at interface #2 (and #1) rather than a large increase in cask anchor stud tension. Separation at interface #2 will not occur as long as

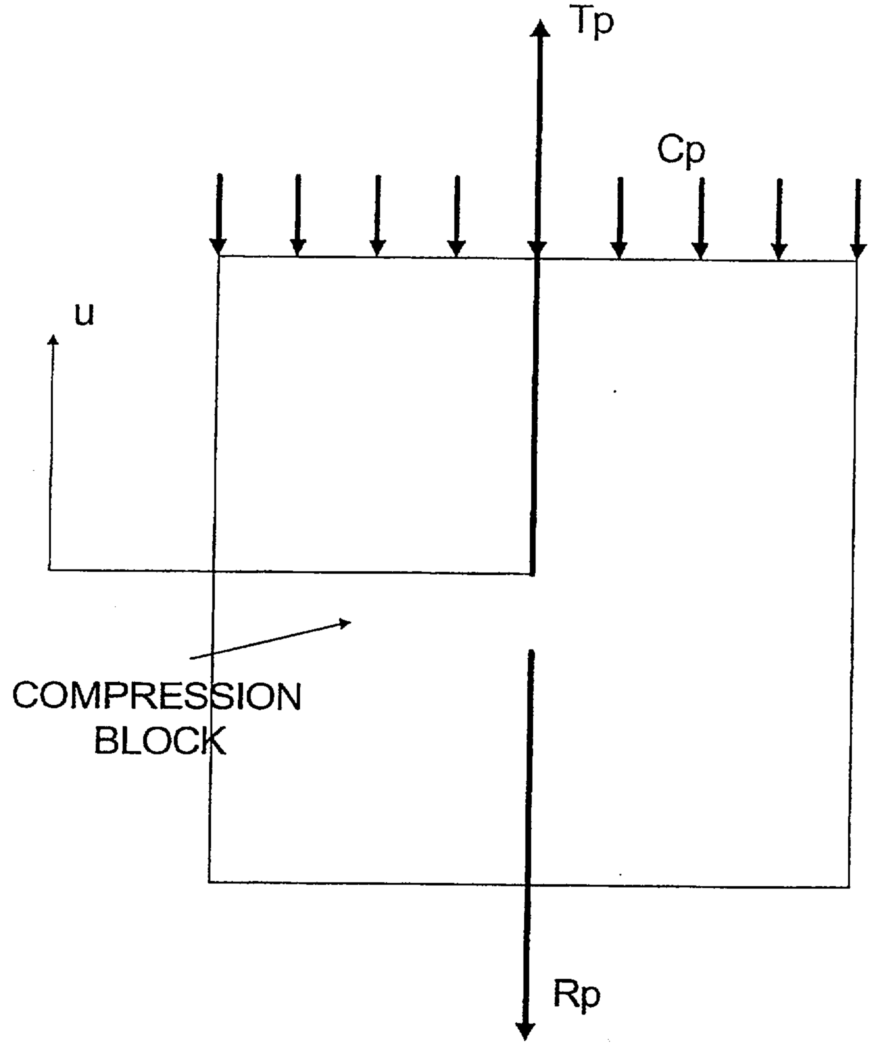
$$C_0 - DT\frac{k_{eff1}}{K_{b1}} > 0 \quad (10)$$

Therefore, since the initial interface compression is equal to the cask anchor stud preload (after creep of the concrete under the embedment plate has occurred so as to eliminate any preload induced in the embedment anchor rods by the preloading of the cask anchor studs), separation at the metal-to-metal interfaces occurs when the change in stud tension, DT, satisfies:

$$DT \geq T_0\frac{K_{b1}}{k_{eff1}} \quad (11)$$

Equation (11) permits the computation of the maximum incremental cask anchor stud tension that will lead to local separation at the cask/embedment plate interface and at the embedment plate/compression block interface.

We now consider the initial preload operation. The following sketch shows the compression block subject to initial preload "Tp" in the cask anchor studs, which is resisted by interface compression "Cp", and induced tension "Rp" in the embedment anchor rod.



The equilibrium equation is

$$Tp = Cp + Rp$$

Tp is assumed to be specified and Cp and Rp are related to "u", the average movement of the compression block, by the relations:

$$Cp = k_{effl}\ u$$

$$Rp = K_r\ u$$

The stiffness values for the compression elements and for the anchor rod are given in Appendix A. Solving the three equations for u, Cp, and Rp gives the results:

$$Cp = \frac{Tp}{1 + {Kr}/{k_{eff1}}} \qquad Rp = \frac{{Kr}/{k_{eff1}}\, Tp}{1 + {K_r}/{k_{eff1}}}$$

From Appendix A, the cask anchor stud stiffness divided by the interface compression stiffness is:

$$\frac{K_{B1}}{k_{eff1}} = 0.177$$

Since the nominal diameters of the cask anchor stud and the embedment rod are equal, the ratio of anchor rod stiffness interface to interface compression stiffness (based on elastic length) is:

$$\frac{K_r}{k_{eff1}} = 0.177x\frac{8.296875''}{48''} = 0.030595$$

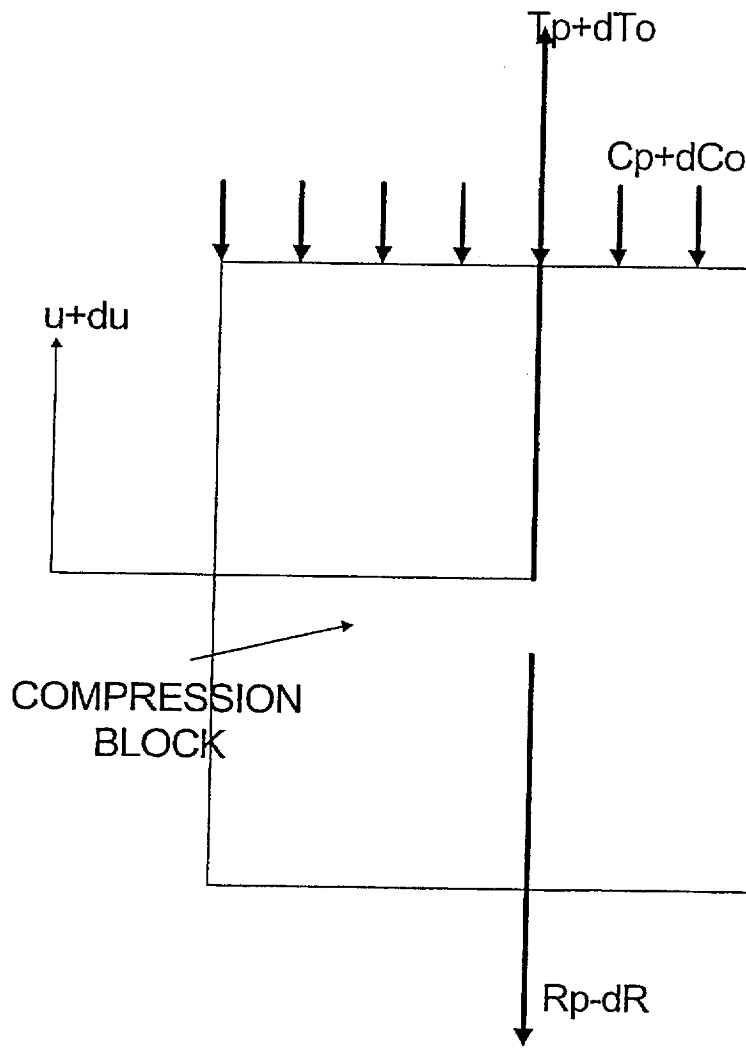
Using the value,

Tp = 157,000 lb. (approximate value per stud simulated in dynamic analysis)

with the appropriate stiffness ratios, gives

Cp = 0.970314 Tp = 152,339.2 lb. Rp = 0.029686 Tp = 4,660.7 lb.

The anchor rod tension that develops is resisted by the cone of concrete surrounding the anchor rod. Since concrete will creep, the anchor rod induced tension, "Rp", will relax over time and the initial preload and the interface compression will change to accommodate the relaxation. The sketch below shows the configuration during the relaxation period.



The equilibrium equation relating the incremental changes in load, after using the relation between Tp, Cp, and Rp, is:

dTo =dCo –dR ; dR = Rp (complete relaxation of the anchor rod load)

We also make use of the incremental force-deflection relations:

$dTo = -K_{B1} \times du$ $dCo = k_{eff1} \times du$

The solution for the incremental load changes is:

$$dTo = -\frac{\frac{K_{B1}}{k_{eff1}} Rp}{1 + \frac{K_{B1}}{k_{eff1}}} = -0.150382x4{,}660.7lb. = -700.887lb.$$

$$dCo = \frac{Rp}{1 + \frac{K_{B1}}{k_{eff1}}} = 3{,}959.813lb.$$

Therefore, after the relaxation has occurred, the cask anchor stud preload and the interface compression between the cask and the embedment and between the embedment and the compression block have the values:

T0 = Tp + dTo = 156,299 lb.

C0 = Cp +dCo = 156,299 lb

The above computation demonstrates that there is a 0.445% difference in the preload due to the presence of the embedment anchor rods during the initial preloading of the cask anchor studs. This small difference is ignored in the remaining analyses. Returning to equation (11), above, the incremental cask anchor stud tensile load, prior to local separation at the base of the overpack, is calculated as:

DT = 27,789 lb.

The results of the post-processing are unfiltered results that contain high frequency peaks due to the large stiffness values associated with the interface. While it is recognized that these peaks appear to be correlated in time with MPC-to-HI-STORM impacts, for structural analysis purposes and comparison with allowable stresses appropriate for static load scenarios, the results are filtered at 40Hz, a frequency that ensures complete capture of the input energy content from the input seismic excitation. The commercial code MATLAB is used to filter the results from the postprocessor. Appendix C contains a typical "m" file for the MATLAB session. The input is the output time histories of the vertical force and moments from the Fortran code in Appendix C and the output is a direct plot of the unfiltered and filtered results on a single plot. This particular "m" file has previously been used to support the data analysis of the HI-STAR impact limiter tests described in the HI-STAR 100 SAR (10CFR71 application).

8.0 COMPUTER FILES

All relevant computer files associated with this calculation package are archived on the Holtec Server. A directory listing of computer files is given below:

The seismic zip files contain individual VN files and excel spreadsheets with all meter data.

The post-process zip file contains all files associated with the post-processing.

This report, appendices, and zip files for the finite element runs are found in the directory:

Projects\1073\ais\reports\hi2012618\rev1. This directory was created on 3/1/01

A listing appears below:

REV 1

Select an item to view its description.

See also:

My Documents

My Network Places

My Computer

Name	Size	Type	Modified
~$2012618r1.DOC	1 KB	Microsoft Word Doc...	3/1/2001 4:11 PM
Anchor Figures.doc	184 KB	Microsoft Word Doc...	2/20/2001 12:42 PM
ANCHOR-1.jpg	136 KB	JPEG Image	2/23/2001 5:09 PM
APPENDA rev1.mcd	119 KB	Mathcad Document	3/1/2001 1:55 PM
APPENDB.doc	59 KB	Microsoft Word Doc...	1/31/2001 12:24 AM
APPENDC.doc	71 KB	Microsoft Word Doc...	2/28/2001 7:49 AM
Cover Page.pdf	10 KB	Adobe Acrobat Doc...	1/31/2001 2:46 PM
FIGURES for REV...	510 KB	Microsoft Word Doc...	2/24/2001 12:53 PM
HE Accel 4-7% IS...	78,438 KB	WinZip File	2/20/2001 9:12 AM
HE Neg VT post.xls	4,550 KB	Microsoft Excel Wor...	2/24/2001 11:50 AM
HENEGpost.xls	8,797 KB	Microsoft Excel Wor...	2/26/2001 3:26 PM
hepost.xls	8,823 KB	Microsoft Excel Wor...	2/25/2001 1:21 PM
Hi2012618r1.DOC	25,979 KB	Microsoft Word Doc...	3/1/2001 3:47 PM
Hi2012618r1.zip	7,123 KB	WinZip File	3/1/2001 3:49 PM
LTSP Accel 5-5% I...	75,227 KB	WinZip File	2/20/2001 8:24 AM
ltsp figs.doc	115 KB	Microsoft Word Doc...	2/26/2001 11:15 AM
ltsppost.xls	8,797 KB	Microsoft Excel Wor...	2/26/2001 3:52 PM
MX-HEOUT.txt	488 KB	Text Document	2/23/2001 12:35 PM
MX-ltspnegOUT.txt	487 KB	Text Document	2/25/2001 11:54 AM
MX-LTSPOUT.txt	488 KB	Text Document	2/24/2001 10:16 AM
MX-NEGHEOUT.txt	488 KB	Text Document	2/24/2001 11:27 AM
MX-NEGLTSPOU...	488 KB	Text Document	2/24/2001 12:29 PM
MY-HEOUT.txt	488 KB	Text Document	2/23/2001 12:37 PM
MY-ltspnegOUT.txt	487 KB	Text Document	2/25/2001 12:15 PM
MY-LTSPOUT.txt	488 KB	Text Document	2/24/2001 10:23 AM
MY-NEGHEOUT.txt	488 KB	Text Document	2/24/2001 11:37 AM
MY-NEGLTSPOU...	488 KB	Text Document	2/24/2001 12:36 PM
Neg HE Figs.doc	114 KB	Microsoft Word Doc...	2/26/2001 7:49 AM
NEG HE VT 02-21...	75,105 KB	WinZip File	2/22/2001 7:40 AM
Neg LTSP FIGS.doc	118 KB	Microsoft Word Doc...	2/25/2001 12:21 PM
NEG LTSP VT 2-2...	75,477 KB	WinZip File	2/24/2001 7:44 AM
NEG LTSP VT po...	11,989 KB	Microsoft Excel Wor...	2/24/2001 12:13 PM
Negltsppost.xls	8,799 KB	Microsoft Excel Wor...	2/25/2001 1:16 PM
postprocess 2-24-...	43,082 KB	WinZip File	2/26/2001 3:54 PM
Poststud.exe	408 KB	Application	2/25/2001 1:25 PM
POSTSTUD.FOR	5 KB	Fortran Source File	2/25/2001 1:23 PM
re1figs.doc	149 KB	Microsoft Word Doc...	2/5/2001 8:38 AM

For revision 2, the relevant files are located in the directory

Projects\1073\ais\reports\hi2012618\rev2.

A listing appears below:

REV2

Select an item to view its description.

See also:
My Documents
My Network Places
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Name	Size	Type	Modified
sectorLug FEA		File Folder	5/4/2001 2:22 PM
APPENDA rev1.mcd	119 KB	Mathcad Document	3/1/2001 1:55 PM
APPENDB.doc	59 KB	Microsoft Word Doc...	1/31/2001 12:24 AM
APPENDBr2.doc	58 KB	Microsoft Word Doc...	4/4/2001 3:18 PM
APPENDC.doc	71 KB	Microsoft Word Doc...	2/28/2001 7:49 AM
Cover Page.pdf	10 KB	Adobe Acrobat Doc...	1/31/2001 2:46 PM
Hi2012618r2.DOC	56,371 KB	Microsoft Word Doc...	4/29/2001 10:43 AM
interface.vsd	18 KB	VISIO 4 Drawing	4/5/2001 8:40 AM
interim rev2 text.pdf	12,279 KB	Adobe Acrobat Doc...	5/4/2001 9:22 AM

The finite element analyses results for the revised sector lug analyses are located in the following directories:

\projects\1073\jz\sector lugs\preload\final run

Final-Run

Select an item to view its description.

See also:
My Documents
My Network Places
My Computer

Name	Size	Type	Modified
Anchor-P1AV.inp	7 KB	INP File	4/6/2001 3:25 PM
BC.jpg	124 KB	JPEG Image	4/6/2001 3:24 PM
Load.jpg	122 KB	JPEG Image	4/6/2001 3:15 PM
Sint-G.jpg	53 KB	JPEG Image	4/6/2001 3:32 PM
Sx-BPlate.jpg	45 KB	JPEG Image	4/6/2001 3:49 PM
Sx-LGusset.jpg	46 KB	JPEG Image	4/6/2001 3:45 PM
Sx-LRing.jpg	47 KB	JPEG Image	4/6/2001 3:42 PM
Sx-RGusset.jpg	44 KB	JPEG Image	4/6/2001 3:48 PM
Sx-URing.jpg	44 KB	JPEG Image	4/6/2001 3:41 PM
Sy-BPlate.jpg	46 KB	JPEG Image	4/6/2001 3:50 PM
Sy-LRing.jpg	47 KB	JPEG Image	4/6/2001 3:42 PM
Sy-shell.jpg	45 KB	JPEG Image	4/6/2001 3:36 PM
Sy-URing.jpg	44 KB	JPEG Image	4/6/2001 3:40 PM
Sz-LGusset.jpg	44 KB	JPEG Image	4/6/2001 3:46 PM
Sz-RGusset.jpg	45 KB	JPEG Image	4/6/2001 3:47 PM
Sz-shell.jpg	45 KB	JPEG Image	4/6/2001 3:35 PM

\projects\1073\jz\sector lugs\seismic\final run

Final-Run

Select an item to view its description.

See also:
My Documents
My Network Places
My Computer

Name	Size	Type	Modified
Anchor-S2AV.inp	7 KB	INP File	4/5/2001 4:40 PM
NewModel.jpg	194 KB	JPEG Image	4/5/2001 1:11 PM
Sint-BPlate.jpg	45 KB	JPEG Image	4/5/2001 4:53 PM
Sint-G.jpg	63 KB	JPEG Image	4/5/2001 4:46 PM
Sint-LGusset.jpg	46 KB	JPEG Image	4/5/2001 4:52 PM
Sint-LRing.jpg	49 KB	JPEG Image	4/5/2001 4:50 PM
Sint-RGusset.jpg	45 KB	JPEG Image	4/5/2001 4:53 PM
Sint-shell.jpg	61 KB	JPEG Image	4/5/2001 4:48 PM
Sint-URing.jpg	44 KB	JPEG Image	4/5/2001 4:49 PM
Sz-shell.jpg	53 KB	JPEG Image	4/5/2001 4:47 PM

For Rev. 3, only the main text was updated to incorporate comments. The directory listing is \projects\1073\ais\reports\hi2012618\rev3

REV3

Name	Size	Type	Modified
Hi2012618r3.DOC	59,186 KB	Microsoft Word Doc...	6/17/2001 8:12 AM
Response to Com...	1,874 KB	Microsoft Word Doc...	6/17/2001 8:11 AM
rev3 doc only.zip	12,817 KB	WinZip File	6/17/2001 8:15 AM

For revision 4, there were only text changes – the updated file is in \projects\1073\ais\reports\hi2012618\rev4 (see footer).

For Revision 5, the revised Main Text and the revised Appendix A are located in the new subdirectory. All other files that are unchanged remain in their respective directories above.

\projects\1073\ais\reports\hi2012618\rev5 (see footer).

9.0 RESULTS OF ANALYSES

9.1 *Quasi-Static Analyses*

A conservative assessment of the safety factors in the sector lugs under stud tension is obtained by performing a finite element analysis of a repeated element of one of the sector lugs containing a pretensioned stud. Figure 8 shows the modeled section and the finite element mesh and boundary conditions. The sector lug portion modeled involves two gussets, and the associated HI-STORM shell section encompassing 50% of an inlet air duct and one-half of the structure between the stud being simulated and the next stud around the periphery. Figure 9.1 shows the loads applied for the preload condition. For the load case simulating preload, the bounding stud load of 160 kips is applied as a uniform pressure applied over a 5"x 5" section of the extended baseplate simulating the washer between two gussets. The balancing loading from the interface is applied as a pressure over the extended baseplate flat plate surface between the adjacent gussets. For the load case involving preload plus seismic excitation, the bounding case of local separation is considered and a load conservatively equal to the stud capacity is applied as a uniform pressure load over the 5"x 5" load patch simulating the washer. The most limiting segment of the sector lug is the portion containing one stud that is adjacent to an inlet duct. Two cases are considered: (1) the pre-loaded state (a Normal Condition of Storage-Level A stress limits apply); and, (2), the seismic load condition at the location of the maximum tensile load in a stud (an Accident Condition of Storage – Level D stress intensity limits apply). Figures 9.2-9.14 and 10.1-10.9 present stress results for the following representative load conditions, respectively.

Level A Analysis – Preload /stud = 160 kips (bounds the applied preload of 157 kips).
Level D Analysis – Maximum Load Per Stud = 214.4 kips (bounds computed load and is slightly below the ultimate capacity of 215.6 kips computed in Appendix A)

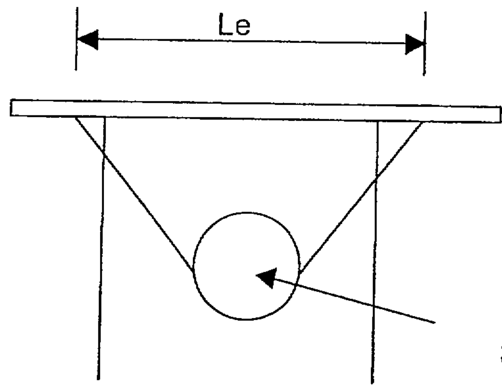
In the Level A analysis, the resisting local foundation pressure exactly balances the preload. For the Level D analysis, local separation is conservatively assumed (it is demonstrated in Subsection 9.2 that there is no separation) and a bounding load approximately equal to the limit load permitted for the stud (70% of stud material ultimate strength) is assumed. The use of this load permits evaluation of the HI-STORM sector lug stress state under tensile load independently from the results of the various dynamic analyses.

The ANSYS input files are given in Appendix B.

The discussion below details how the safety factors for the sector lug are computed. Table 2 is a summary of the key results Allowable values are from Tables 3.1.10 and 3.1.12 of [11.4] for SA-516 Grade 70 @ 200 degrees F. The results reported in the summary table below are based on visual examination of applicable figures for each load case. For the preload case, primary and secondary stresses are considered. However, as Level D evaluations consider only primary membrane and primary bending stresses, secondary stresses arising from discontinuity stresses arising in the sector lug flat plate sections are disregarded in the evaluation of safety factors. For the fatigue evaluation, however, local stress intensities near the shell connection and adjacent to the load patch are considered. Finally, it is noted that since the results presented in Subsection 9.2 demonstrate that the maximum cask anchor stud load will not exceed 165,000 lb., computed safety factors in Table 2, based on the ultimate capacity of the stud as a load input, may be further amplified by the multiplier 1.31 (see calculations in Subsection 9.2 below).

For the preload case, the ASME Code stress limits are based on maximum stress; Figure 9.2, however, provides a sense of the state of stress in the component under preload by a stress intensity plot for the entire component modeled. Figures 9.3-9.14 provide the individual surface stresses on the structural members making up the sector lug region under study. The largest stress computed anywhere in the sector lug is a circumferential stress in the lower annular plate section under the loaded region (Figure 9.6). The allowable stress for this primary bending stress is 1.5 x Code allowable membrane stress at temperature. Table 2 provides the computed safety factor. Independent confirmation of the magnitudes of the applied loading is provided by a compilation of the vertical reactions at all nodes restrained in this direction. As expected, the net vertical reaction at restrained nodes is zero.

For the seismic load case where separation is assumed to occur, Figure 10.1 documents the surface stress intensity state for the entire modeled sector lug. A check of the net vertical reaction load at the restraint nodes provides confirmation that the correct maximum stud capacity load has been used as the input load. We note the existence of large values for surface stress intensity near the region directly loaded by the stud, at the joint between the upper annular ring and the shell, and at local points where sharp corners appear in the model. These last areas are not considered as the large stress intensities arise solely from the neglect of corner radii in the finite element model. Therefore, for evaluation of primary stress intensity safety factors, we need consider only the results from Figures 10.2, 10.3, and 10.7 that show the distributions for the baseplate and lower annular ring, and for the overpack shell. Specific results used herein are obtained from visual evaluation of the graphical results. From Figures 10.2 and 10.3, the stress intensity in the baseplate and annular ring, at the location of the overpack shell connection, is 48,309 psi. From Figure 10.3, the stress intensity under the load is 43,010 psi. The extent of circumferential length over which a stress state should be considered as primary at this location is established from the following figure that shows a portion of the lower annular ring and the stud location between two gussets and the overpack shell viewed from above.



Assuming that the "region of influence" of the stud extends back to the overpack/shell joint at a 45-degree angle, the result for "Le" is 9 inches. Although the gussets are not shown in Figure 10.3, it is easily established that the extent of the region stresses to 48,309 psi is about 50% of "Le". Therefore, the safety factor in Table 2 for primary stress intensity in the baseplate/lower annular ring is computed using 43,010 psi.

Now consider the surface stress intensity in the overpack shell in the region above the sector lug upper annular ring shown in Figures 10.1 and 10.7. The maximum value is 86,641 psi but clearly this value is applicable only for a fatigue evaluation. To differentiate between primary and secondary state of stress intensity, we note that the "bending boundary layer" in a shell is proportional to $(Rt)^{1/2}$ with a proportionality factor of at least 2 usually applied. For the shell dimensions R=66.25" and t=0.75", $(Rt)^{1/2}$ = 7.05". Therefore, stress intensities closer than 7.05" (in the vertical direction) to the annular ring and less than 14.1" in circumferential extent are clearly of a secondary nature. Based on the above consideration, from Figures 10.1 and 10.7, the primary stress intensity is set at 43,722 psi for the purpose of establishing the Level D safety factor. A review of the results for the remaining components of the sector lug shows no higher primary stress intensity state. The key results are summarized below:

TABLE 2

SUMMARY OF RESULTS FOR SECTOR LUGS FROM STATIC FEA EVALUATION			
Item	Calculated Value from FEA	Allowable Value from FSAR	Safety Factor = (Allowable Value/Calculated Value)
Maximum Primary Membrane + Bending Stress (ksi) – Case 1 - Preload (Figure 9.6)	10.23	26.3	2.57
Maximum Primary Membrane + Bending Stress Intensity in Lower Annular Ring Away From Discontinuity (ksi) – Case 2 – Stud Capacity (Figure 10.3)	43.01	62.3	1.45
Maximum Primary Membrane + Bending Stress Intensity Overpack Shell Away From Discontinuity (ksi) – Case 2 – Stud Capacity (Figures 10.1 and 10.7)	43.72	62.3	1.43
Maximum Baseplate Shear Stress (ksi) (Appendix A, Sec. 5)	10.21	29.4	2.88
Maximum Weld Shear Stress – Lower Annular Ring-to-Gussets and Overpack (ksi) (Appendix A, Sec. 5)	26.997	29.4	1.089
Maximum Weld Shear Stress – Gusset-to-Overpack Shell (ksi) (Appendix A, Sec. 5)	23.482	29.4	1.518
Maximum Secondary Stress Intensity (ksi) Fatigue Evaluation (Figure 10.7)	86.64	Fatigue	Not Applicable

The most limiting weld stress is obtained by evaluating the available load capacity of the fillet weld attaching the extended baseplate annulus region to the gussets and to the shell. In Appendix A, this weld calculation is performed for the cask anchor stud loading based on the Level D limit stud load. Figures 10.8 and 10.9 are used in the weld analysis to evaluate the moment at the base of the gusset about a radial axis.

9.2 Dynamic Analyses

Figures 11 through 46 show results of the dynamic analysis using the design basis seismic time histories as input accelerations to the ISFSI pad. Figure 11-19 present results for the LTSP event, Figures 20-28 present results for the HE event, Figures 29-37 present results for the LTSP event with vertical seismic excitation direction reversed, and Figures 38-46 present results for the HE event with vertical seismic excitation direction reversed.

We note that the dynamic simulation, which uses an impulse-momentum relationship to simulate the rattling contact between the MPC and the HI-STORM, leads to results having a number of sharp peaks during the high intensity period of the motions that are found to correspond to lateral and vertical impacts of the MPC. As noted earlier, given that the stress intensity limits in the Code assume static analyses, filtering of the dynamic results is certainly appropriate prior to comparing with any static allowable strength. To ensure capturing all seismic energy content (primarily occurring at a frequency below 25 Hz), a filtering frequency of 40 Hz is applied to the interface compression, to the overturning moments, and to the embedment anchor rod tension loads. Subsequent combinations of these quantities to form net moments and shears are made using the filtered results from the simulations.

The interface loads and moments at the embedment/ISFSI pad concrete interface are summarized in tabular form in Table 3. These interface loads are obtained from the post-processing algorithm established in Section 7. Graphical results for the interface loads and moments are reported for both unfiltered and filtered (after removal of higher frequency (above 40Hz) peak values). The filtered results are obtained directly from the output graphics from the Matlab processing (note that the title on each Matlab graph reports the filtered peak values).

TABLE 3

SEISMIC EVENT AT ISFSI	HE	LTSP	HE**	LTSP**
Maximum/Minimum Interface Compression Force (kips)***	674.2/127.6	684.1/105.8	773.3/130.6	632.0/55.6
Maximum Interface Shear Force Along X axis (kips) *	509.4	432.0	379.9	325.8
Maximum Interface Shear Force Along Y axis (kips)*	460.5	355.5	426.1	364.6
Maximum Net Interface Shear Force (kips)	515.0	440.0	428.0	390.0
Maximum Interface Moment About X Axis at Interface (kip-in.)	54,564	42,139.2	50,498	43,209
Maximum Interface Moment About Y Axis at Interface (kip-in.)	60,369	51,197.2	45,017	38,603
Maximum Net Interface Moment (kip-in)	61,000	52,000	50,500	46,000
Effective COF at Cask/Embedment Interface	0.180	0.154	0.150	0.132
Maximum Tensile Load in Embedment Anchor Rods (kip)	62.13	48.85	49.73	42.34

* Base Maximum Shear forces are computed by dividing the appropriate maximum moment by the height to the centroid (118.5 inch). Y-Shear goes with MX, X-Shear goes with MY.

** These simulations have the vertical excitation reversed in direction over the total event time.

*** Includes dead load = 360,000 lb.

Subsequent to the anchored cask analyses, it was determined that the Hosgri seismic event at 7% damping required scaling-up by 7% [Reference 11.14] in order to meet SRP 3.7.1 spectral matching criteria; the Hosgri time histories for 4% & 5% damping, however, need no scaling [Reference 11.14] to conform to SRP 3.7.1 spectral matching requirements. The LTSP seismic event, which does not provide bounding loads for the pad design, needs scaling at 5% [Reference 11.14] in order to completely satisfy SRP criteria. We note, however, that the LTSP does not provide the bounding inputs for the pad design; this remains true even if the results for the LTSP input are scaled up by 5%. If we therefore limit discussion to the bounding HE, in order for the results reported in Table 3; to be completely in conformance to the regulations, no more than 5% damping should be associated with the cask/concrete compression interface (the reported results are based on 4% steel/ 7% concrete damping for the Hosgri event per Appendix A). It is our considered opinion, based on engineering judgment that the effect of a decrease in the damping at this location (all other damping values are at 4%) would lead primarily to additional amplifications only for high frequency contributions. Since the results of interest for pad design are filtered to remove components above 40 Hz, we expect that a damping reduction at the concrete/cask interface will have negligible effect on the results reported in Table 3.

The maximum net shear at the base of the embedment plate is 515 kips. Based on the bounding cask weight of 360 kips, we see that the effective "g" loading on the cask is

$G_{eff} = 515/360 = 1.43$

It is clear that the cask design basis deceleration level (from the FSAR) of 45 g's is not exceeded during the seismic event.

Subsection 3.4.7.1 of [11.4] presents stress results for a load of 169.2 kips applied at the center of a cask that is considered fixed to the ISFSI slab. The maximum membrane stress in the overpack steelwork due to this lateral load is computed in [11.4] as

S = 1,573 psi

Therefore, under the amplified lateral load induced by the seismic event, the HI-STORM shell metal stress is

S1 = S x 515/169.2 = 4,788 psi

From Table 3.1.12 of [11.4], the allowable primary membrane stress intensity (@ 350 deg. F) is 22,100 psi. Therefore, the safety factor for the HI-STORM metal shell is:

SF = 22,100/4,788 = 4.62

Figures 19, 28, 37, and 46 are plots of the net shear/current compression force at the steel-to-steel interfaces #1 and #2 (see Figure 1) based on the assumption that the computed compression force at the base of the embedment plate, including the dead weight, is simply increased by the initial steel-to-steel compression force from the pre-load in the cask anchor studs (16 studs x 157 kips/stud = 2,512 kips). The four figures essentially define the coefficient of friction that must exist at the cask/embedment plate interface in order to ensure that there is no relative sliding at that location. From the simulations performed, the largest required value for the coefficient of friction, summarized in Table 3, is 0.18. In accordance with the ASME Code [11.6, NF-3324.6, Table-3324.6 (a)(4)-1], for studs used as frictional joints, we have conservatively assumed interface frictional resistance to be a maximum of 25% of the normal force at the interface (i.e., a minimum coefficient of friction of 0.25 can be assumed to exist at the interface). Therefore, the ratio of minimum available friction coefficient to required friction coefficient is:

$0.25/0.18 = 1.39$

We now examine the steel-to-steel interfaces to ascertain whether there is any local separation between the embedment plate and the compression block and the cask and the embedment plate. As shown in Section 7, the embedment anchor rod tensile load is reacted by a change in tension in the preloaded cask anchor studs and a change in compression at the steel-to-steel interfaces between the cask and the embedment plate and between the embedment plate and the compression blocks. To evaluate the load swing in the cask anchor stud capacity, we note from Table 3 that the maximum excursion in any embedment anchor rod tensile force, "R", is:

$R = 62.13$ kips

Using this value, together with equation (11) in Section 7, and stud and interface stiffness computed in Appendix A, Sec. 2.3, the increase in cask anchor stud tension and the corresponding decrease in the local interface compression is:

$T = 0.15 \times R = 9.3195$ kips; $C = -0.85 \times R = -52.8105$ kips

It has been shown that interface separation will not occur until the incremental change in cask anchor stud tension exceeds

$T_{max} = 27,789$ kips

Therefore, we can define a safety factor against local separation at the cask/embedment plate interface as:

$SF = T_{max}/T = 27.789/9.3195 = 2.982$

Note that this safety factor is simply a measure of the effectiveness of the preload; there is no regulatory requirement that needs to be met.

We now evaluate the safety factors associated with the stud under the loadings associated with maximum filtered tensile load (anywhere). Incorporating the incremental change, T, in the cask anchor stud, the maximum cask anchor stud tension is:

Stud Tension = 157 kip + 9.3195 kip = 166.32 kip.

Under seismic action, the permitted stud load is 215.6 kip (see Appendix A); therefore, the safety factor on cask anchor stud tension is:

$SF = 215.6/166.32 = 1.296$

In accordance with the ASME Code, no shear force need be considered in the stud since the joint has been shown to function as a frictional joint.

Finally, we evaluate the propensity for a fatigue failure under the action of a design basis seismic event. We perform an evaluation of the stud under the expected tensile stress oscillations and a corresponding evaluation of the sector lug. Examination of the four figures showing the embedment anchor rod tensile loads enables identification of a conservative number of stress cycles to characterize fatigue damage.

We can conservatively identify 20 stress cycles that could be considered as contributing to fatigue damage during a seismic event. A maximum load range of 9,320 lb in the cask anchor studs can therefore be identified as bounding for a fatigue calculation. A maximum fatigue reduction factor of 4 is appropriate for the studs (per ASME Code rules). Therefore, a conservative analysis of fatigue for the stud is based on an alternating stress range (stress area of stud = 2.5 sq. inch) of:

S(alt) = .5 x (3,728 psi) x 4 = 7,456 psi for 20 cycles (conservatively assume full range for all 20 cycles).

The ASME Code Subsection NF offers no methodology for evaluation of low-cycle fatigue. Therefore, we use the methodology from Article XIV-1000 of the Code Appendices for Section III. To estimate fatigue life, we use a fatigue curve from the ASME Code for high strength steel bolting materials (Figure I.9.4 in Appendix I, ASME Code Section III Appendices [11.7]). For an amplified alternating stress intensity range of 7,456 psi, Figure I.9.4 in [11.7] predicts cyclic life of approximately 150,000 cycles. Therefore, the safety factor for failure of a stud by fatigue during one design basis LTSP or HE seismic event is

SF(stud fatigue) = 150,000/20 = 7,500.

The result clearly demonstrates that fatigue failure of the anchor stud, from a single seismic event at the Diablo Canyon ISFSI, is not a credible event.

To evaluate the propensity for a failure by fatigue in the sector lug, we use the results from the finite element analysis of the sector lug under the limiting tensile load. From Figure 10.7, the maximum stress intensity range is 86,641 psi just above the overpack shell/upper annular ring connection. We assume that the fatigue reduction factor is equal to increasing the stress intensity by a suitable stress concentration factor, which is associated with an angle in tension. From [11.10, Table 17.1,case 22], Kf=2.50 (assuming a radius equal to the weld size at that location). Then a bounding alternating stress intensity factor for fatigue evaluation of the sector lug is

Sa = .5 x 86,641 psi x 2.5 = 108,301 psi for 20 stress cycles

Using Table I.9.1 (associated with Figure I.9.1) from Appendix I of [11.7], the Safety factor, SF, is computed as

SF = 465 cycles/20 cycles = 23.25

Therefore, we again conclude that a fatigue failure is not credible.

9.3 Environmental Loadings

In contrast to a freestanding HI-STORM 100 System, the anchored overpack is capable of withstanding much greater lateral pressures and impulsive loads from large missiles. In the HI-STORM FSAR [11.4], a number of wind and missile strike evaluations have been performed for a freestanding HI-STORM. The site-specific missile strikes have also been evaluated in [11.12]. The conclusions reached in the FSAR and in the site specific analysis are that missile strikes pose no credible threat to the integrity of the HI-STORM storage system and there would be no potential for cask tipover in the event the HI-STORM were to be considered a free-standing cask. The conclusions for an anchored cask must be the same, insofar as the cask is concerned. However, we note that the ISFSI pad design should evaluate the effect of a large missile strike at the top of the cask based on the assumption that the entire overturning moment must be reacted by the foundation. Reference [11.13] presents estimates for the impact force transmitted to a target. For the values associated with the DC ISFSI, the overturning moment from a site-specific large tornado missile plus tornado wind is computed in [11.12] as:

M(overturning) = 2,448 kip-ft = 29,376 kip-inch

Since this unfiltered moment does not exceed the maximum filtered peak value of 61,000 kip-in reported in Table 3, no additional load case need be considered. The cask can accept this load and meet the requirements of the FSAR even if the cask anchor studs were removed. We conclude that there will be no separation at the cask/embedment plate interface nor will the cask anchor studs be overstressed in the event of a tornado missile strike.

Nevertheless, we report this load case for completeness of the interface loading as an additional case for consideration by the ISFSI pad designer (note that all other casks are subjected only to tornado wind although the case of tornado wind alone will not lead to any appreciable overturning moment compared to the values computed for a seismic event).

Vertical Load = 360,000 lb.
Overturning Moment = 29,376 kip-inch
Shear Load = 127,031 lb (Overturning Moment/Cask Height)

These results bound transmitted loads from all other missile strikes at Diablo Canyon.

The design basis wind is 80 MPH with a 1.1 gust factor [11.12]. Appendix 3.C of the HI-STORM FSAR [11.4] calculates a wind force of 32,730 lb for a 360 mph tornado wind. Therefore, for the design basis wind, the force is estimated as:

F(wind) = 32,730 x $(88/360)^2$ = 1,956 lb

This produces an overturning moment

M(wind) = 1,956 lb x 118.5 inch = 232 kip-inch

The results in Table 3 show clearly that this is an insignificant moment that will be borne primarily by embedment compressive load redistribution, and will add no significant incremental load to the initial stud preload. For the tornado wind speed specified in [11.1, Sec. 6.2.2.3], the force F(wind) is

$F(wind) = 32,730 \times (300/360)^2 = 22,729$ lb

and M(wind) is

M(wind) = 22,729 lb x 118.5 inch = 2693.4 kip-inch

The effects of tornado wind alone, based on the design basis tornado wind in [11.1], outside the fuel handling building will only alter previous results by 4.4% (based on the calculated seismic maximum net moment.

10.0 SUMMARY AND CONCLUSIONS

This backup calculation package supports the structural integrity evaluation of the HI-STORM 100A System required to deploy HI-STORM 100SA casks at the Diablo Canyon ISFSI. All analyses presented here demonstrate the viability of the anchored HI-STORM 100A in a high seismic environment and under external environmental loads.

The results from the series of evaluations performed in this report are summarized below:

The anchored casks do not develop body decelerations that exceed the cask design basis of 45 g's.

The state of stress in the pre-tensioned cask anchor studs and in the cask flange and shell meet the stress limits of the ASME Code Section III, Subsection NF and Appendix F.

The interface loads at the lower surface of the embed plate are summarized in tabular form. The values are obtained from the time histories that result from the dynamic simulations. These time history results are filtered (to remove higher frequency (above 40Hz) peak values) prior to reporting the peak results in the table.

The interface load Table 3, together with the added result for large missile impact, provides the necessary design input to the ISFSI pad designer.

11.0 REFERENCES

[11.1] DCPP Specification 10012-N-NPG, Revision Dated 10/2000.

[11.2] Design Criteria Document for Cask Seismic/Structural Analyses for DCPP, Holtec Report HI-2002478, Revision 0, 2000 (not submitted to PG&E).

[11.3] VisualNastran Desktop, Version 2001, MSC Software, 2001.

[11.4] HI-STORM 100 FSAR, Holtec Report HI-2002444, Proposed Revision 1, 2000.

[11.5] ASME Boiler & Pressure Vessel Code, Section II, Part D, 1998.

[11.6] ASME Boiler & Pressure Vessel Code, Section III, Subsection NF, 1998.

[11.7] ASME Boiler & Pressure Vessel Code, Section III, Appendices, 1998.

[11.8] Mechanical Engineering Design, J. Shigley, and C. Mischke, 5th Edition, McGraw-Hill, 1989.

[11.9] Mechanical Design of Heat Exchangers and Pressure Vessel Components, K.P. Singh, and A.I. Soler, Arcturus Publishers, 1984.

[11.10] Mechanical Design and Systems Handbook, H.A. Rothbart, Editor, 2nd Edition, McGraw-Hill, 1985, Table 17.1.

[11.11] HI-STORM 100 Drawings (1495 (Sheets 1-6, Revs 10,11,9,10,11,4, respectively) and 1561 (Sheets 1-5, Revs. 9,9,9,9,11,respectively)).

[11.12] Holtec Report HI-2002497, Design Basis Wind and Tornado Evaluation for DCPP, Rev.1, April 2001.

[11.13] Design of Structures for Missile Impact, BC-TOP-9A, Rev. 2, Bechtel Power Corporation Topical Report, Sept. 1974.

[11.14] November 1, 2001 Letter from Richard L. Klimczak to Eric Lewis.

12.0 FIGURES

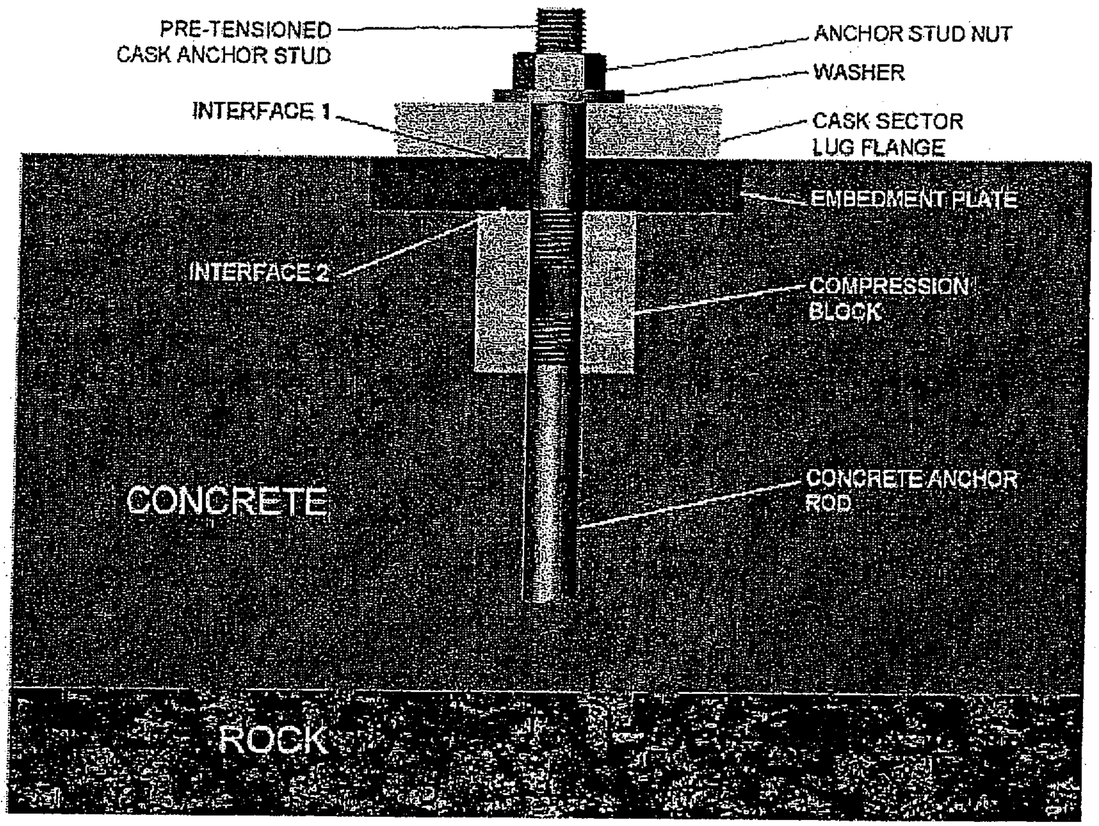


FIGURE 1 –CROSS-SECTION OF ANCHORAGE AT LOCATION OF ANCHOR STUD

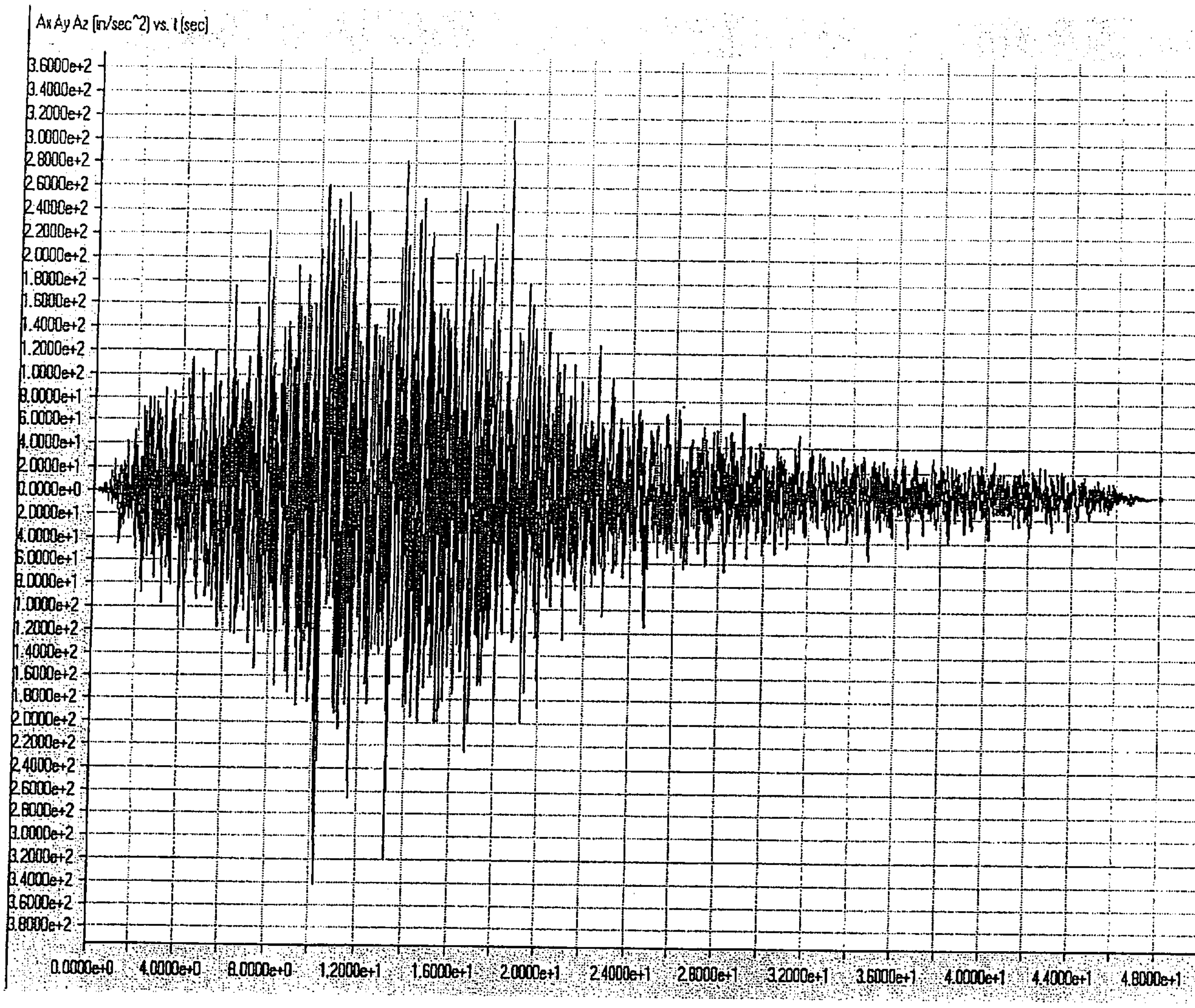


FIGURE 2 LTSP ACCELERATION TIME HISTORIES FOR DIABLO CANYON ISFSI PAD

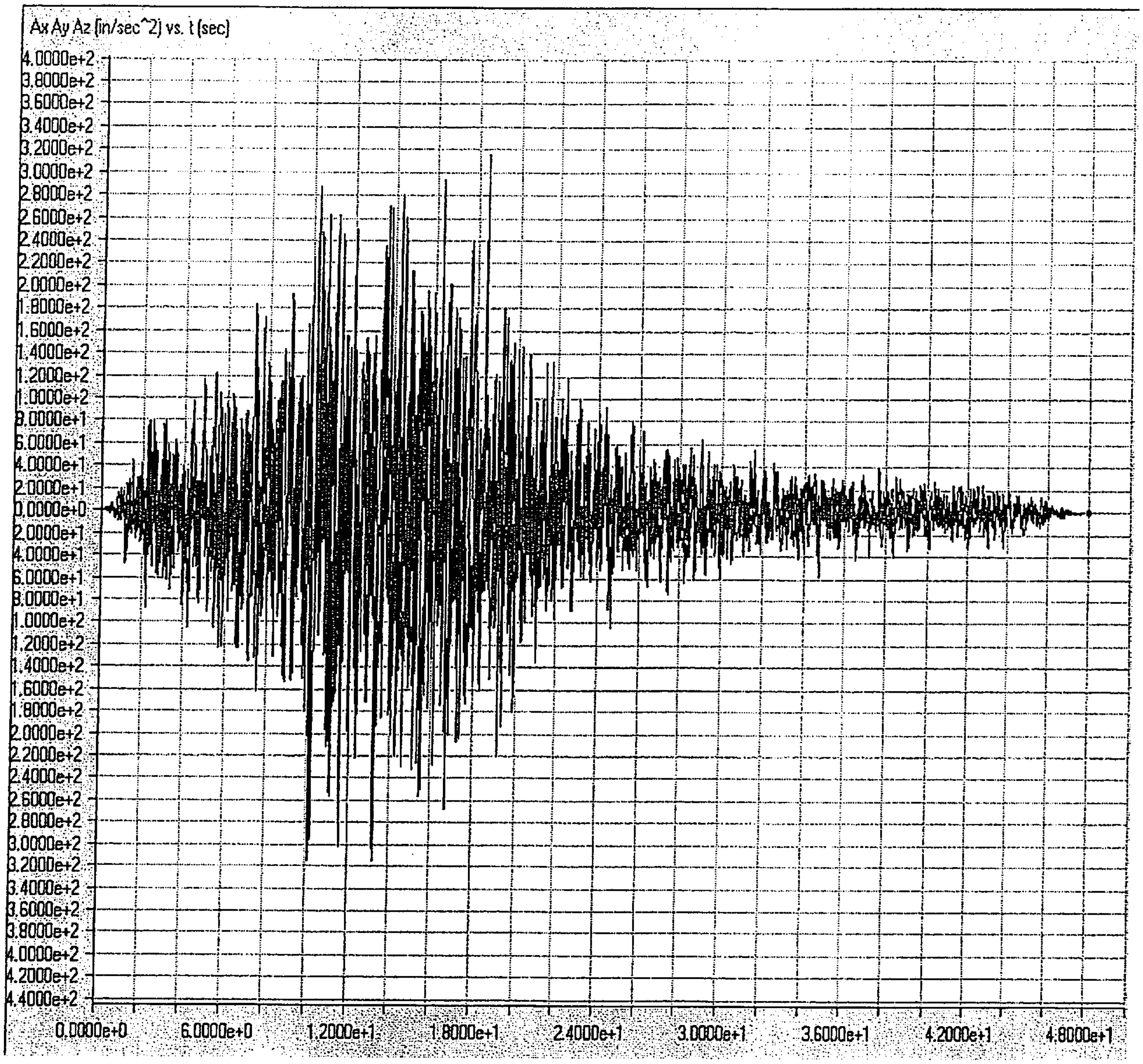


FIGURE 3. – HE ACCELERATION TIME HISTORIES FOR DIABLO CANYON ISFSI PAD

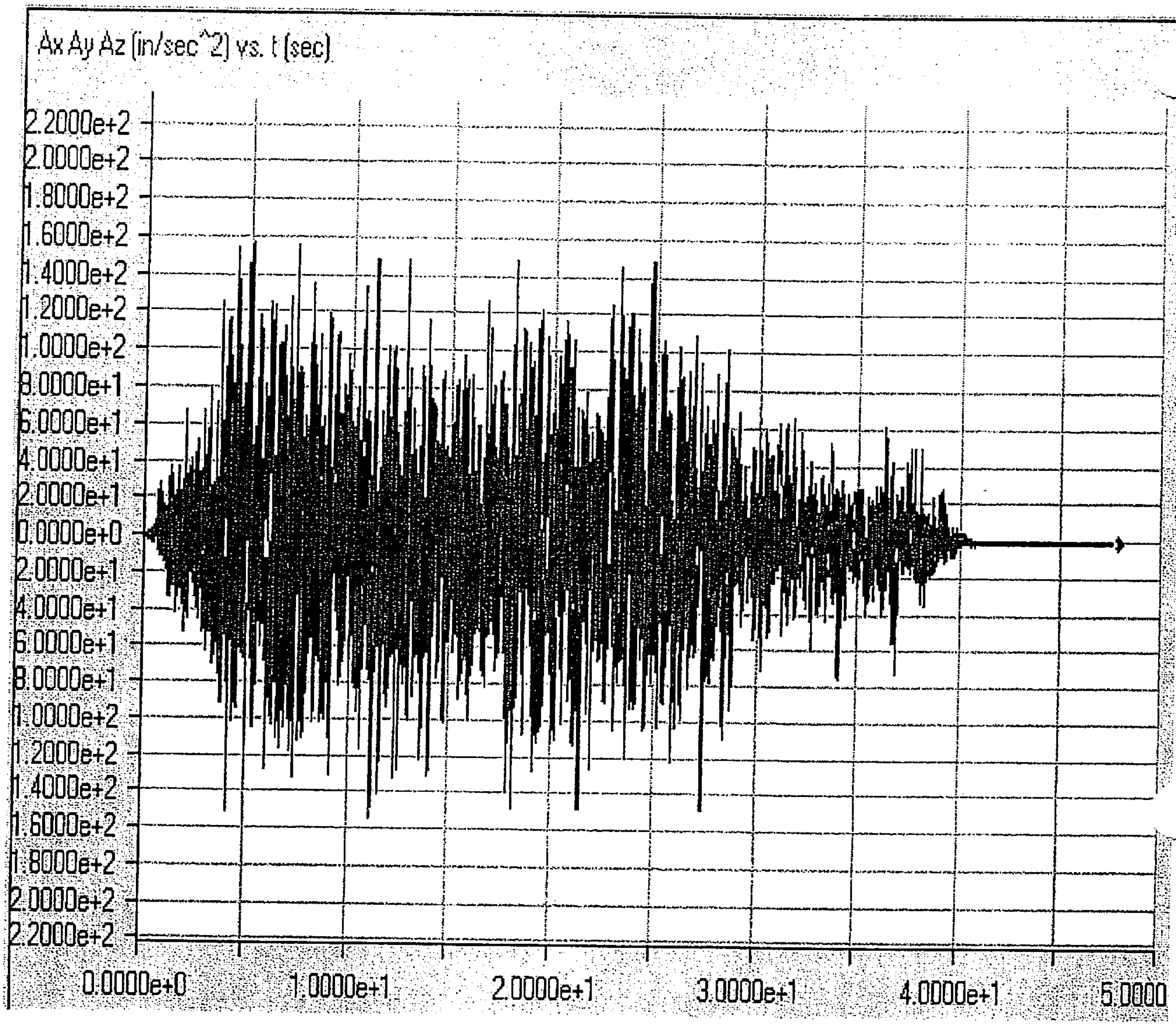


FIGURE 4 – DDE ACCELERATION TIME HISTORIES FOR DIABLO CANYON ISFSI PAD

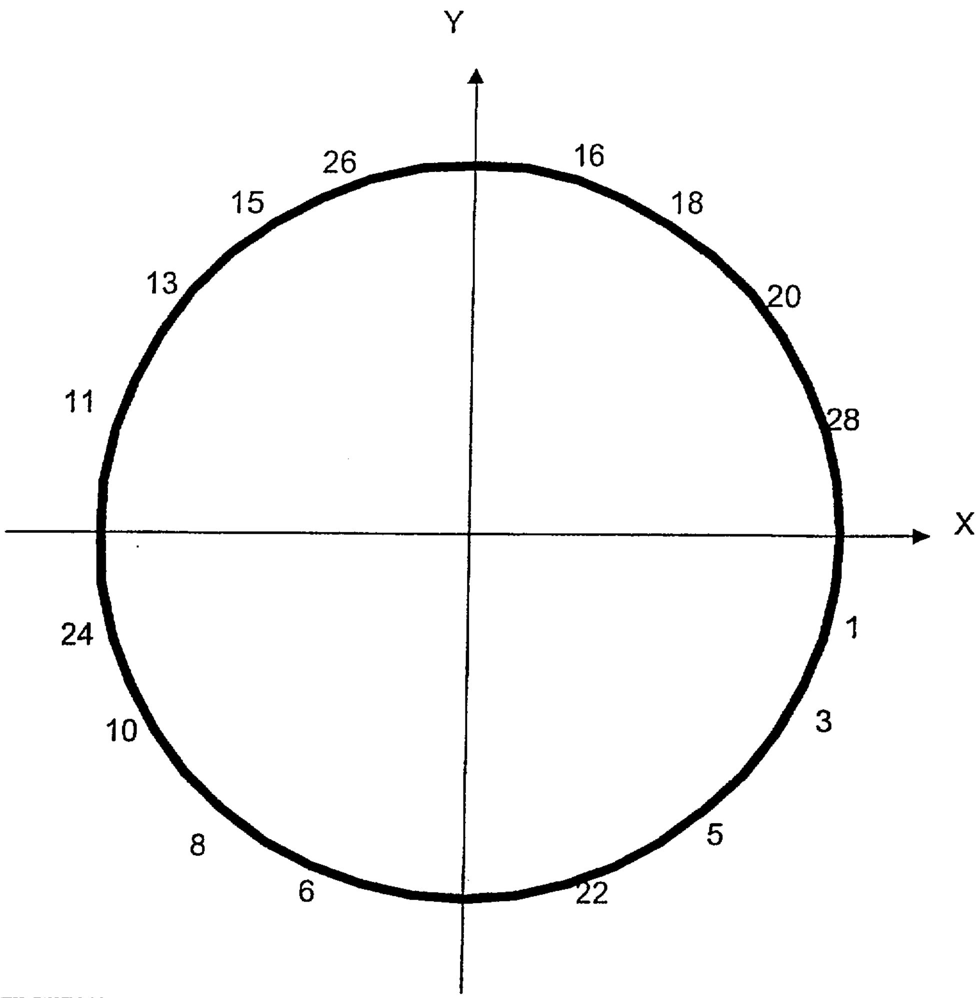


FIGURE 5 – LOCATION OF CASK ANCHOR STUDS AND EMBEDMENT ANCHOR RODS

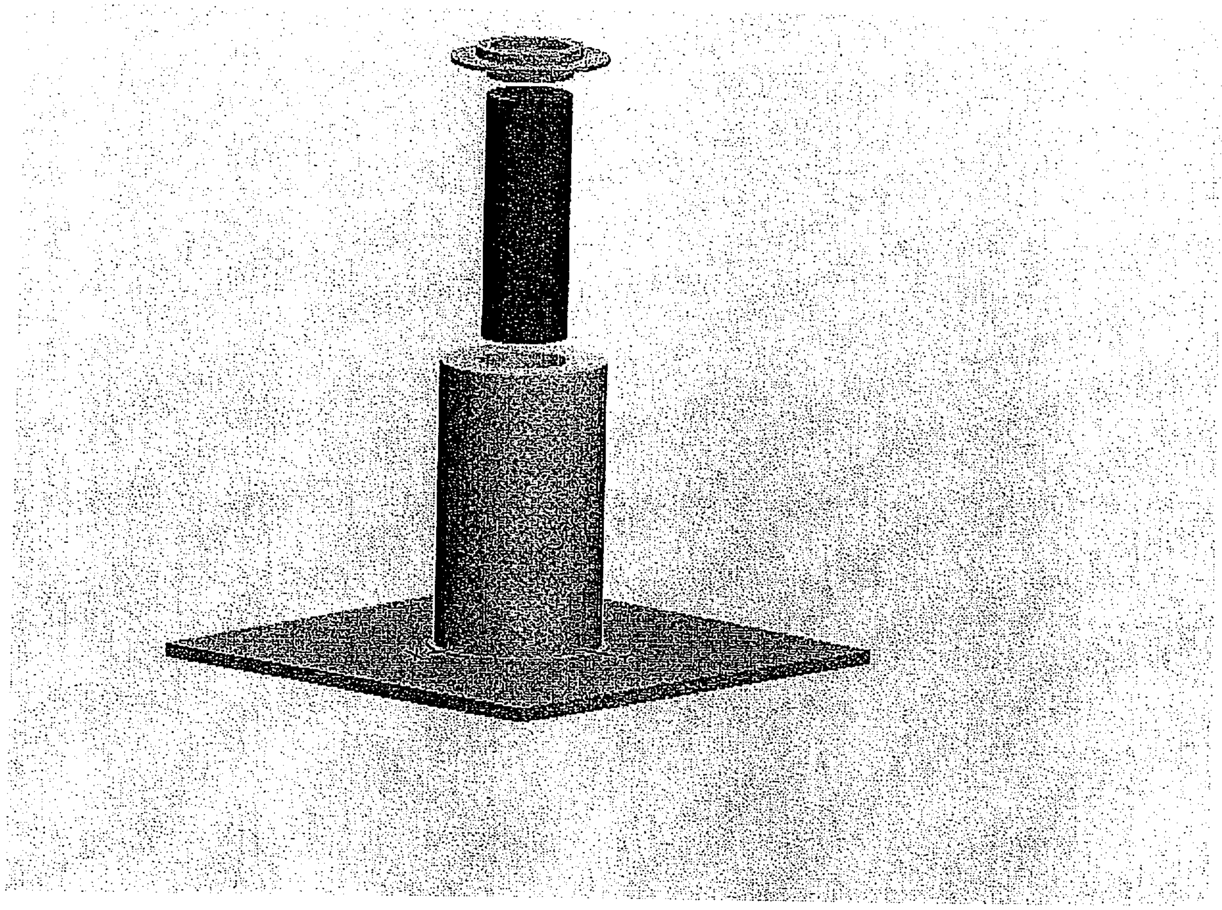


FIGURE 6 EXPLODED VIEW - GROUND PLANE, OVERPACK, MPC, AND OVERPACK TOP LID

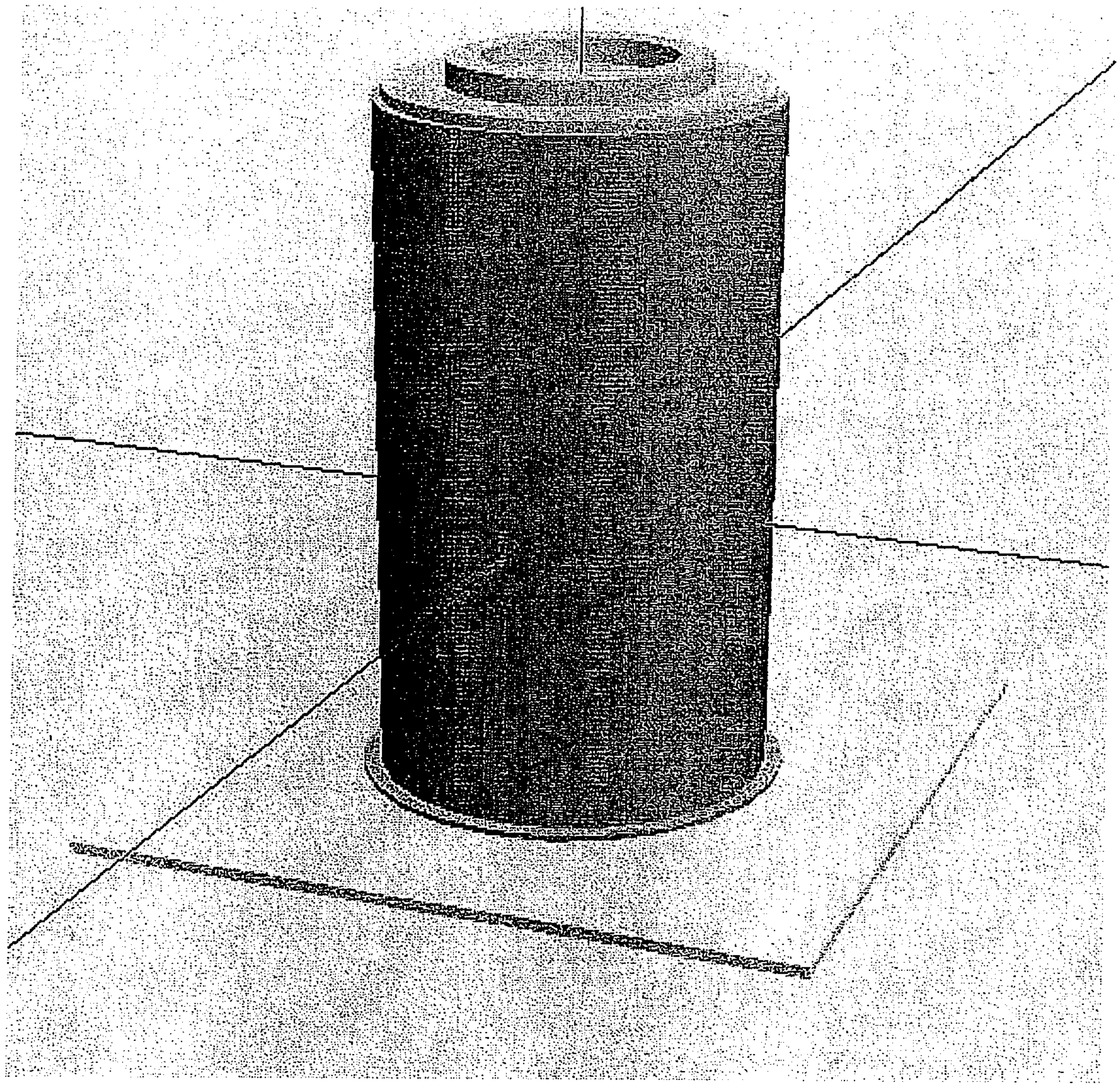


FIGURE 7 ASSEMBLED HI-STORM 100A ON PAD - MPC INSIDE OVERPACK

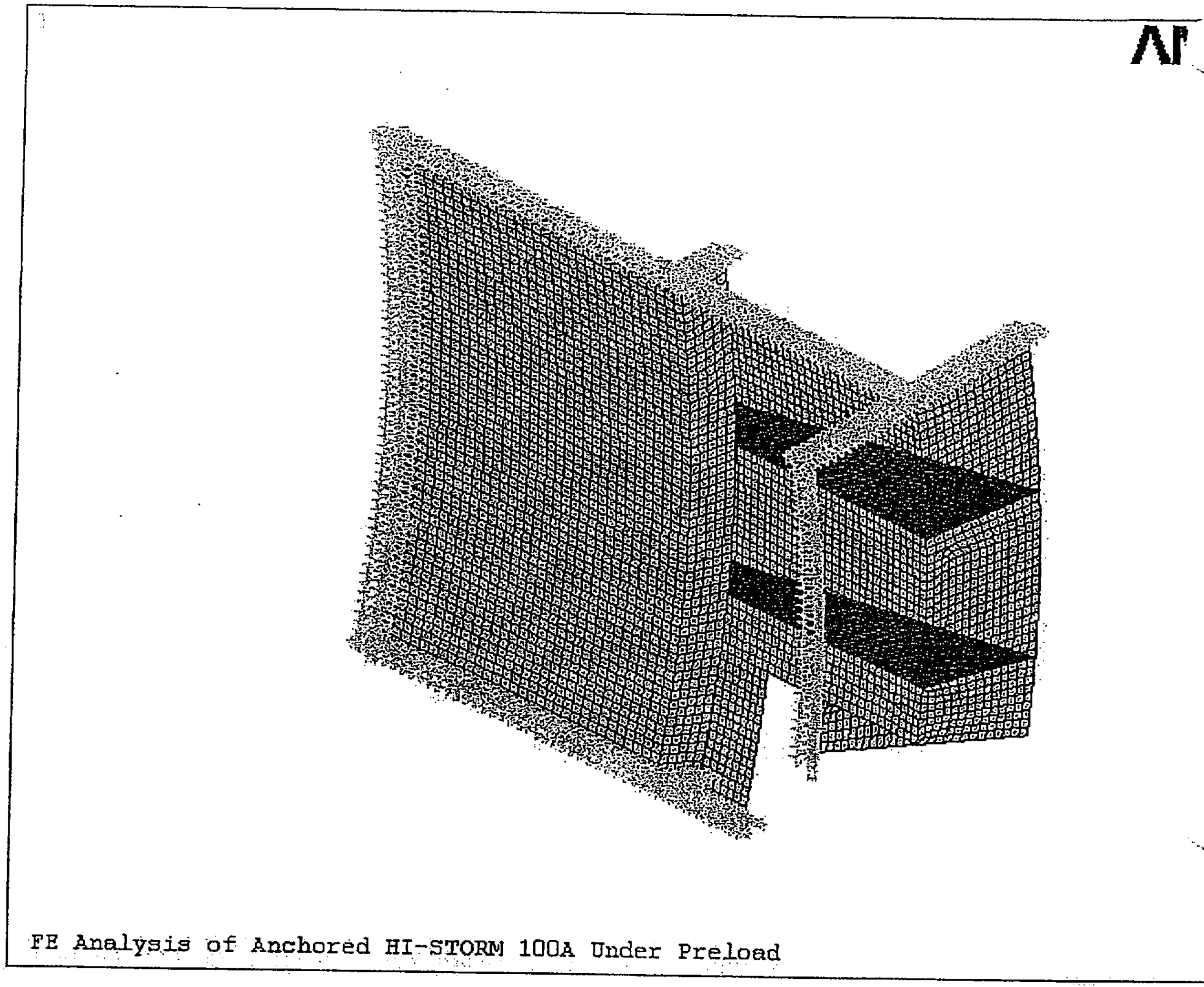


FIGURE 8 SECTOR LUG FINITE ELEMENT MESH AND BOUNDARY CONDITIONS

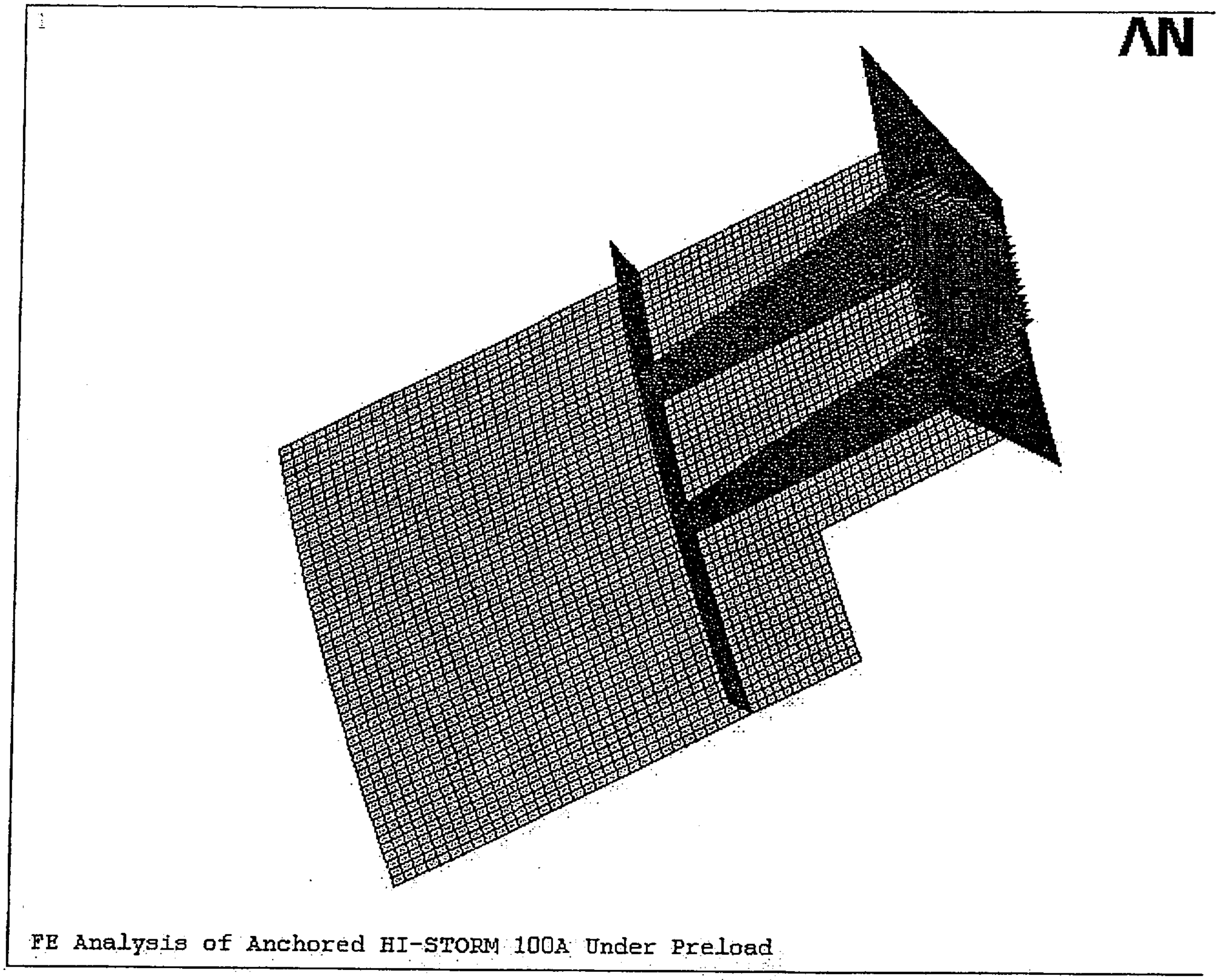


FIGURE 9.1 SECTOR LUG FINITE ELEMENT MESH AND INPUT PRELOADS

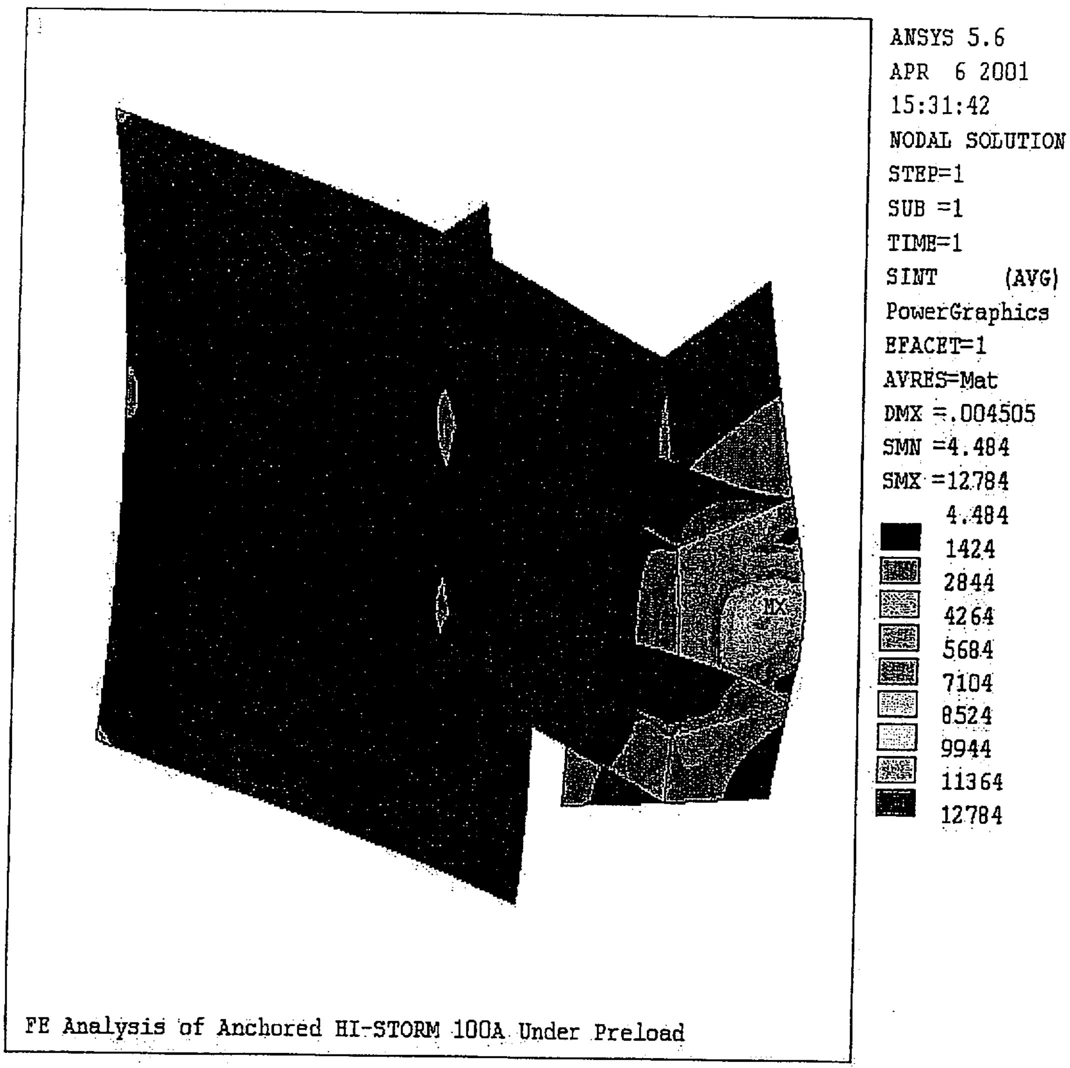


FIGURE 9.2 STRESS INTENSITY DISTRIBUTION –CASE 1 PRELOAD

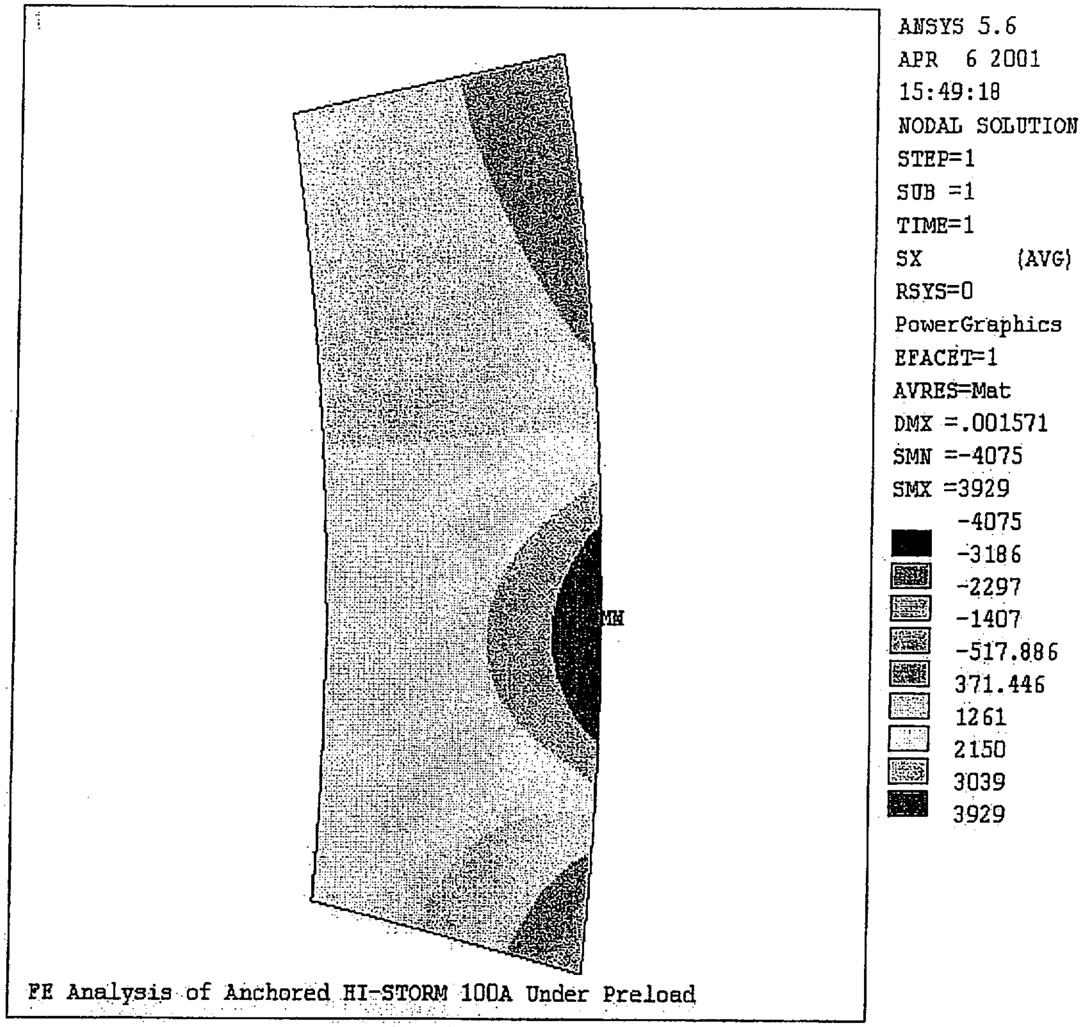


FIGURE 9.3 RADIAL STRESS IN BASE PLATE – CASE 1 PRELOAD

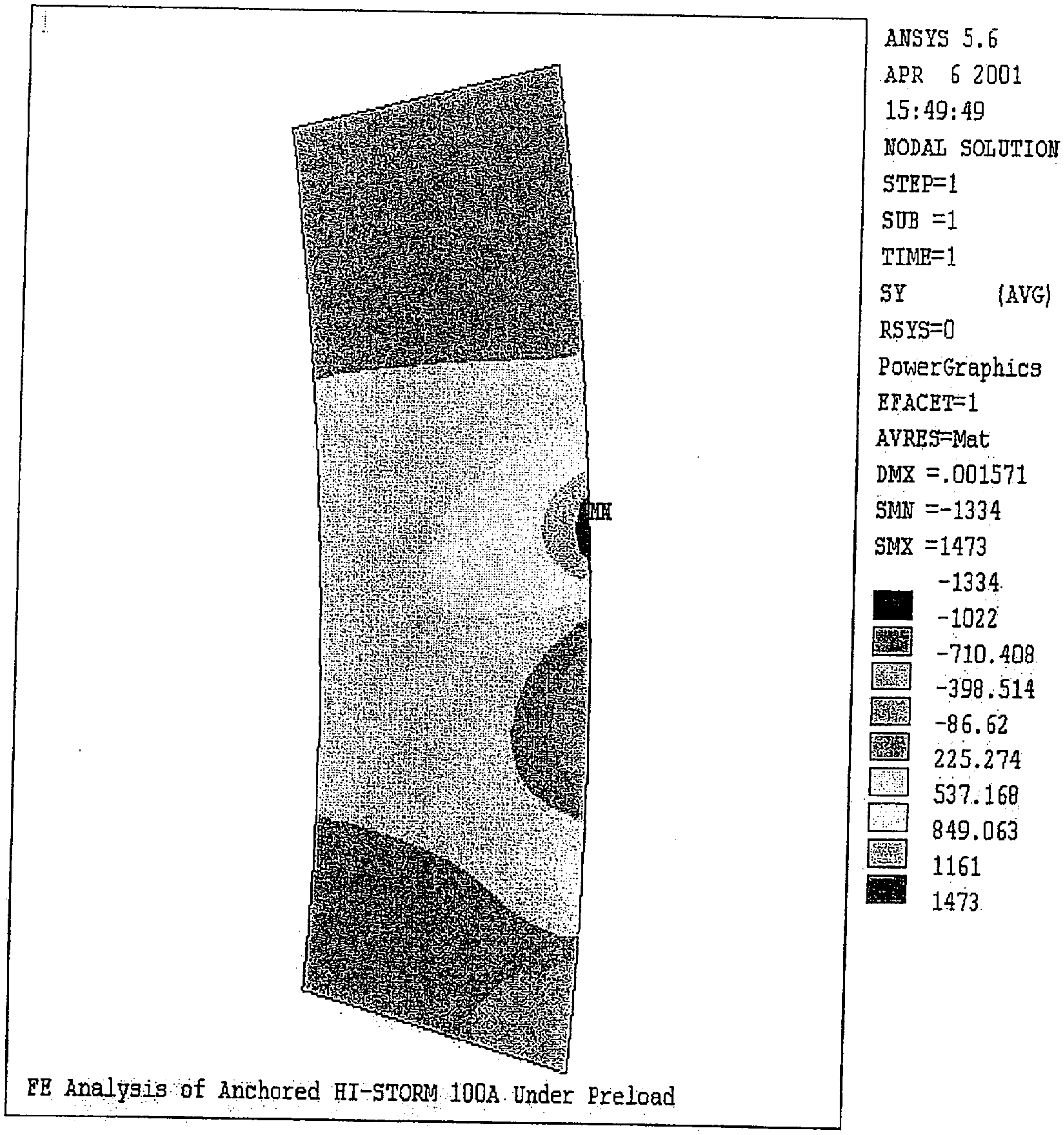


FIGURE 9.4 CIRCUMFERENTIAL STRESS IN BASE PLATE – CASE 1 PRELOAD

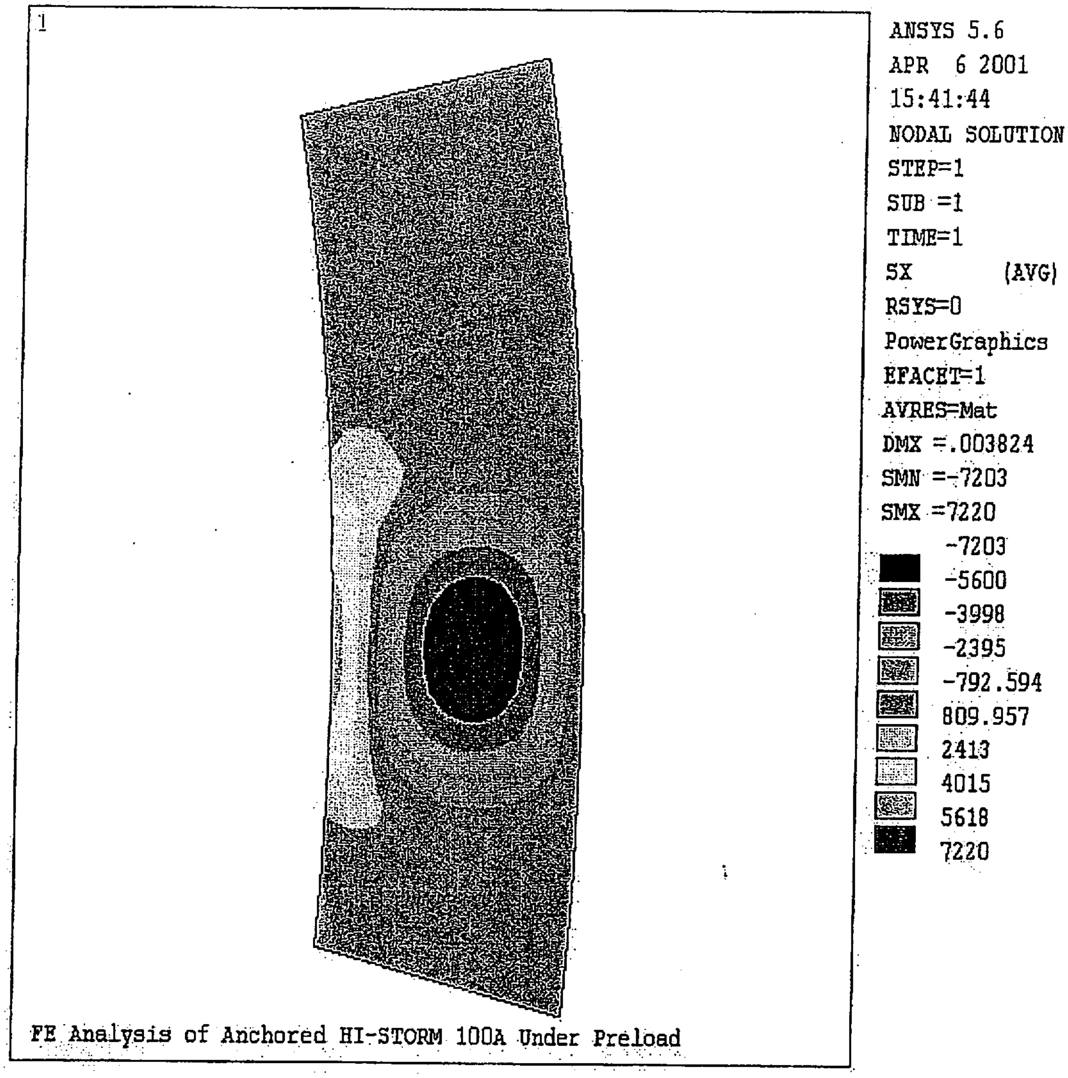


FIGURE 9.5 RADIAL STRESS IN SECTOR LUG LOWER ANNULAR RING – CASE 1 PRELOAD

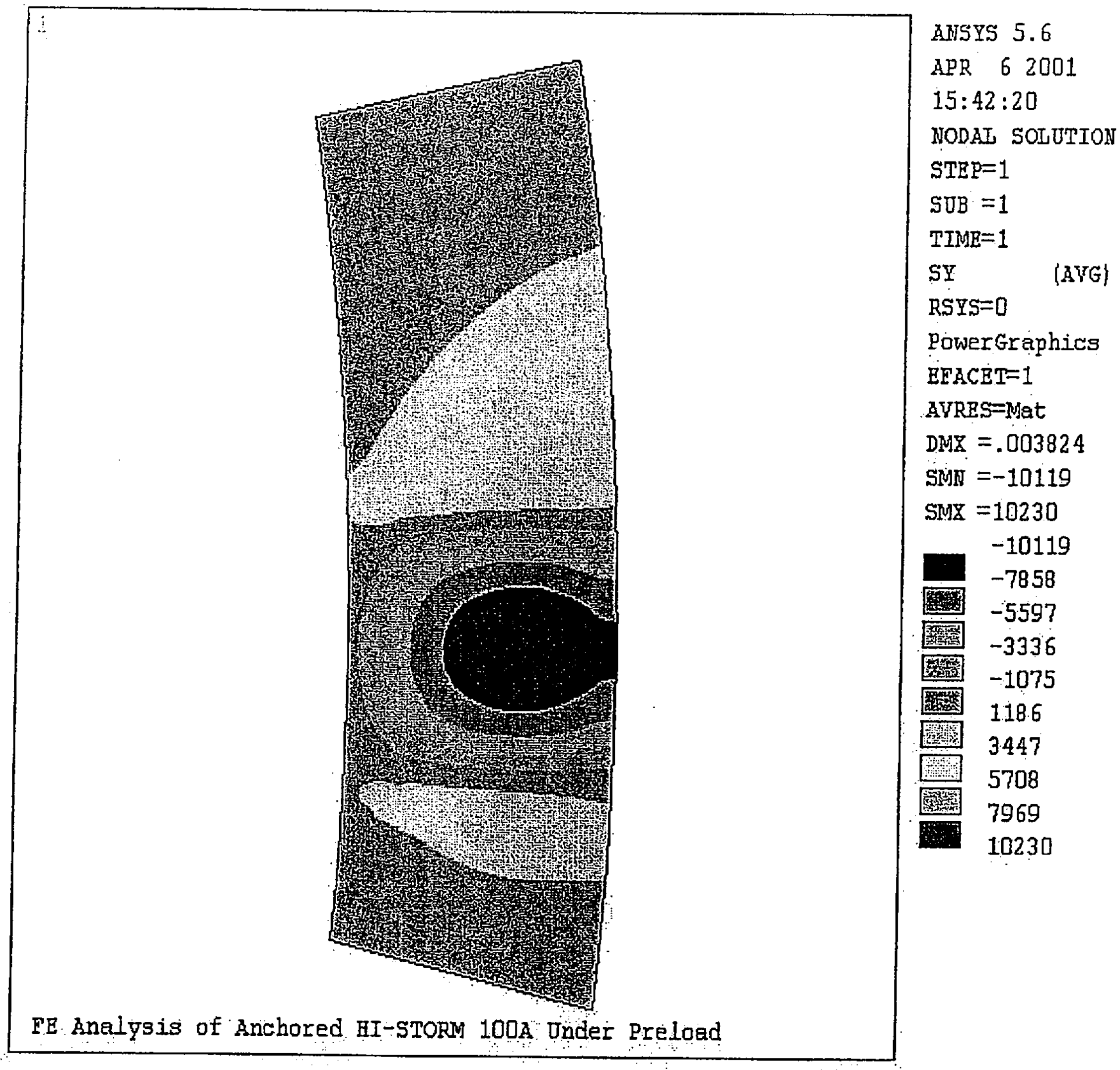


FIGURE 9.6 CIRCUMFERENTIAL STRESS IN SECTOR LUG LOWER ANNULAR RING – CASE 1 PRELOAD

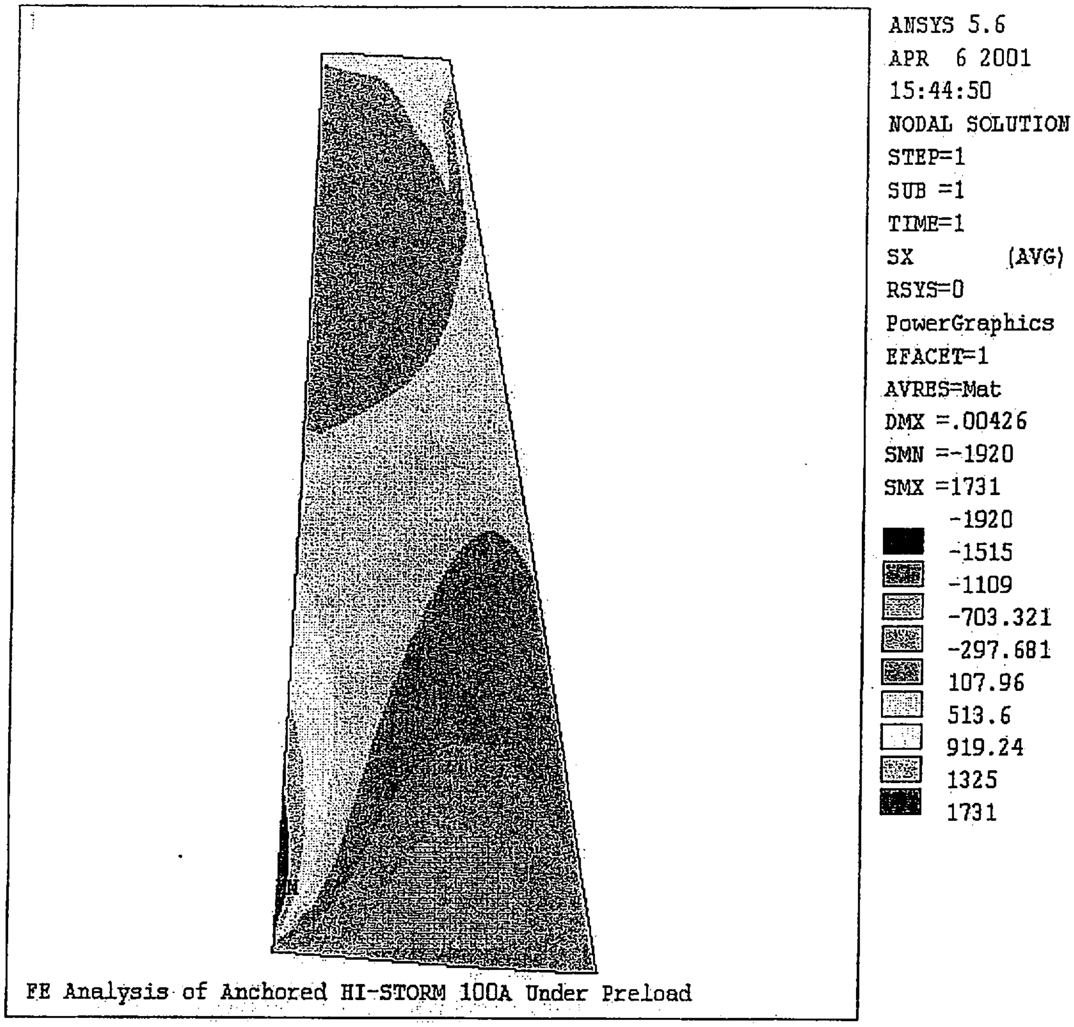


FIGURE 9.7 RADIAL STRESS IN LEFT GUSSET – CASE 1 PRELOAD

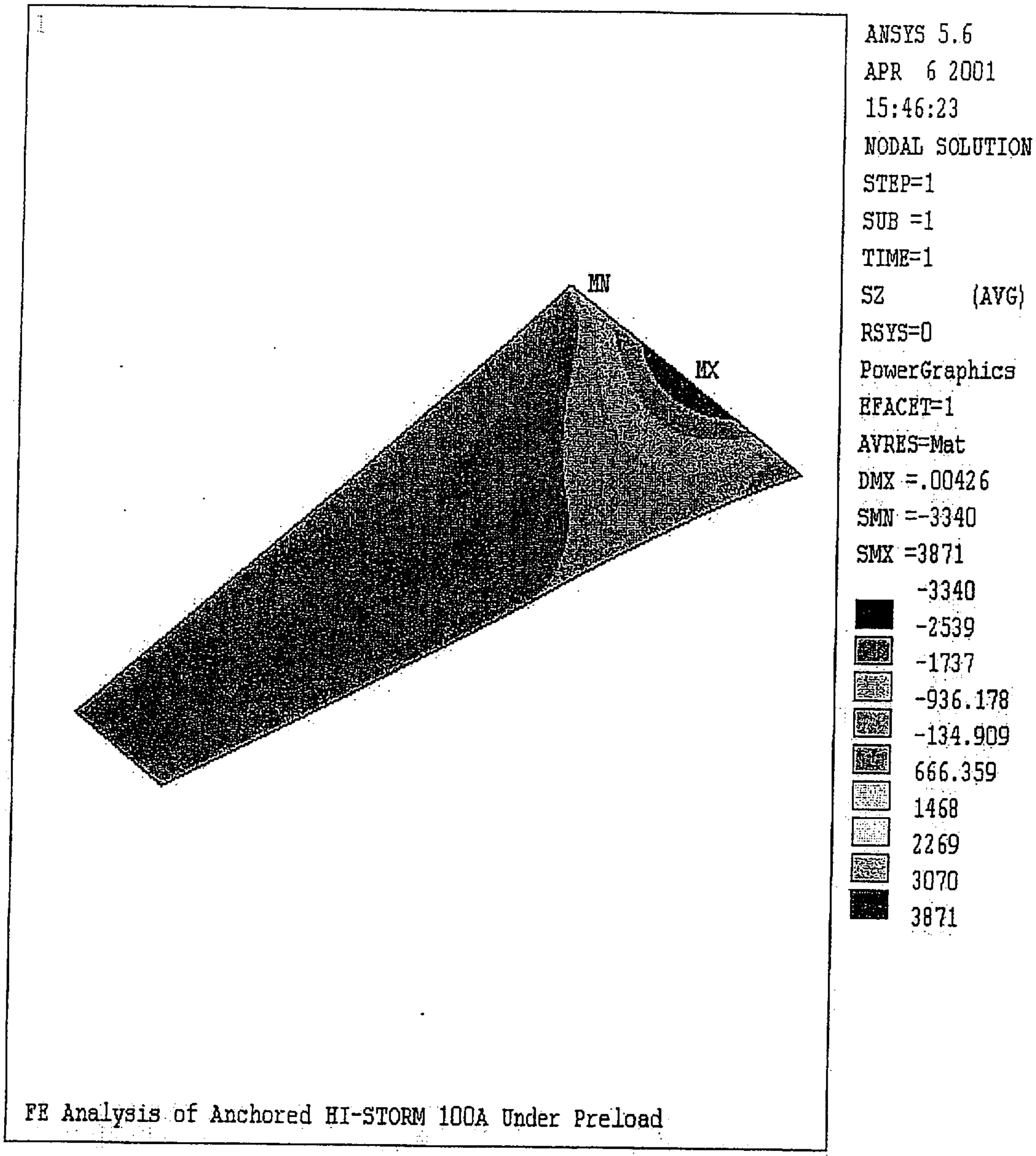


FIGURE 9.8 VERTICAL STRESS IN LEFT GUSSET – CASE 1 PRELOAD

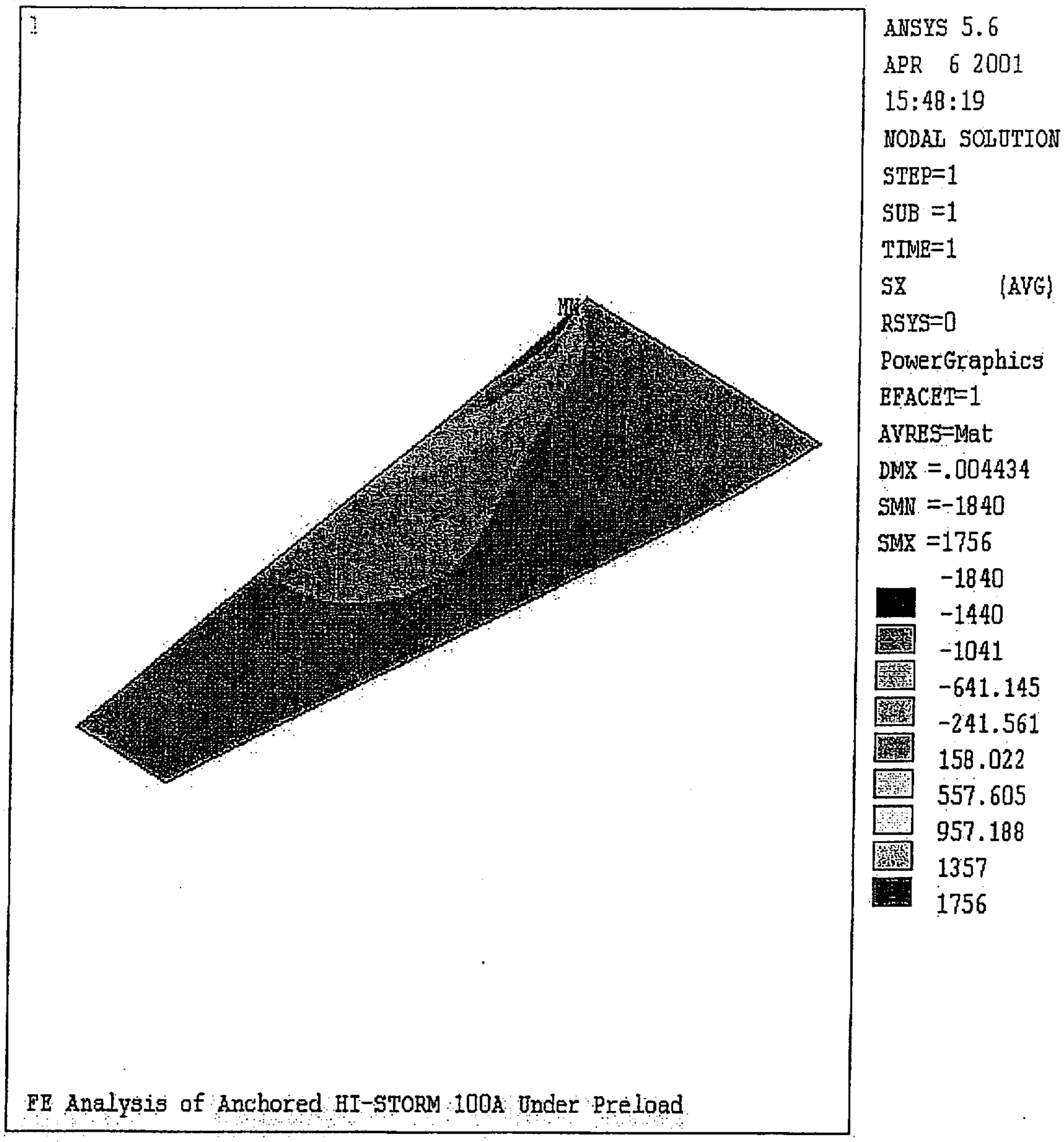


FIGURE 9.9 RADIAL STRESS IN RIGHT GUSSET – CASE 1 PRELOAD

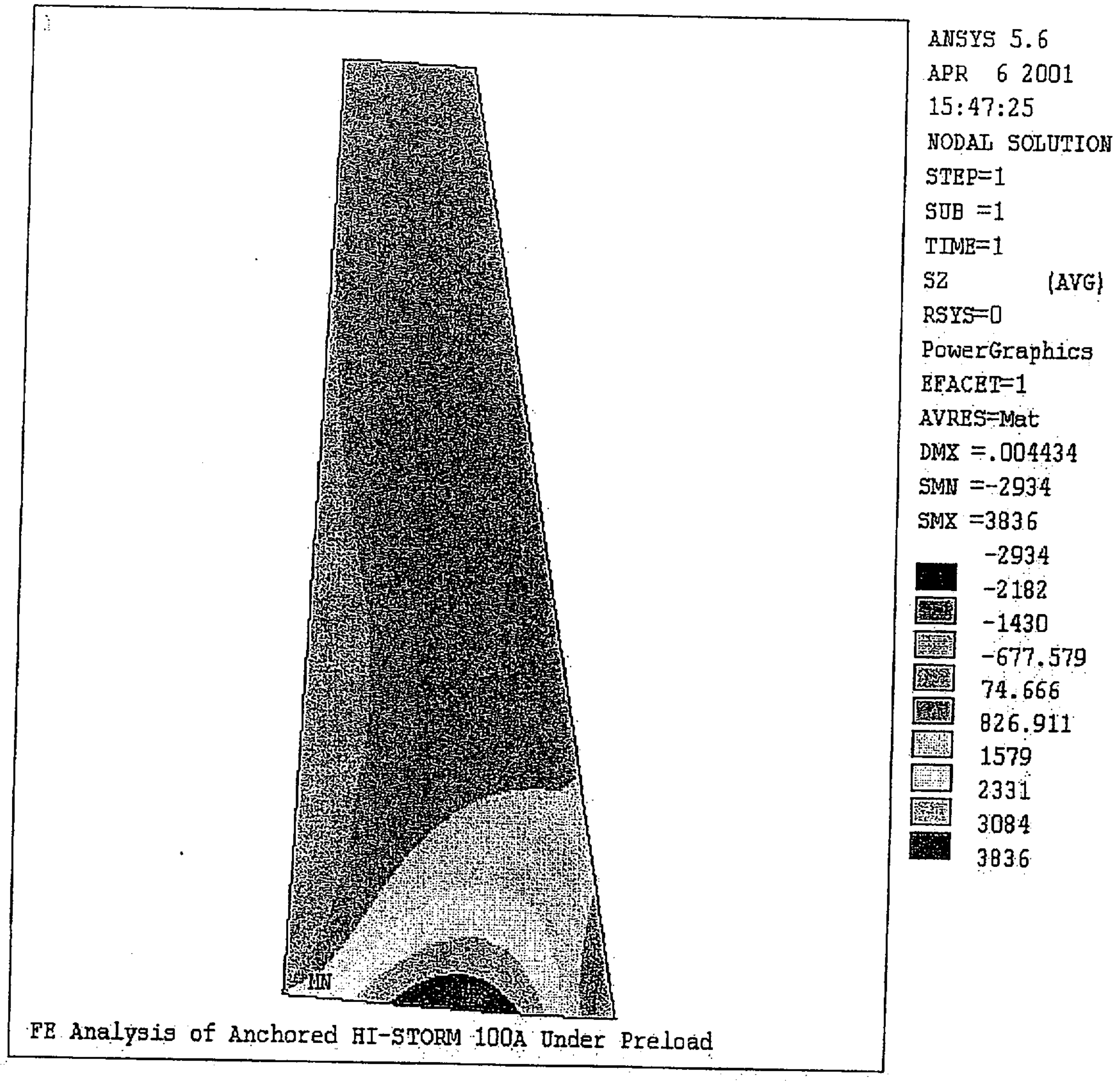


FIGURE 9.10 VERTICAL STRESS IN RIGHT GUSSET – CASE 1 PRELOAD

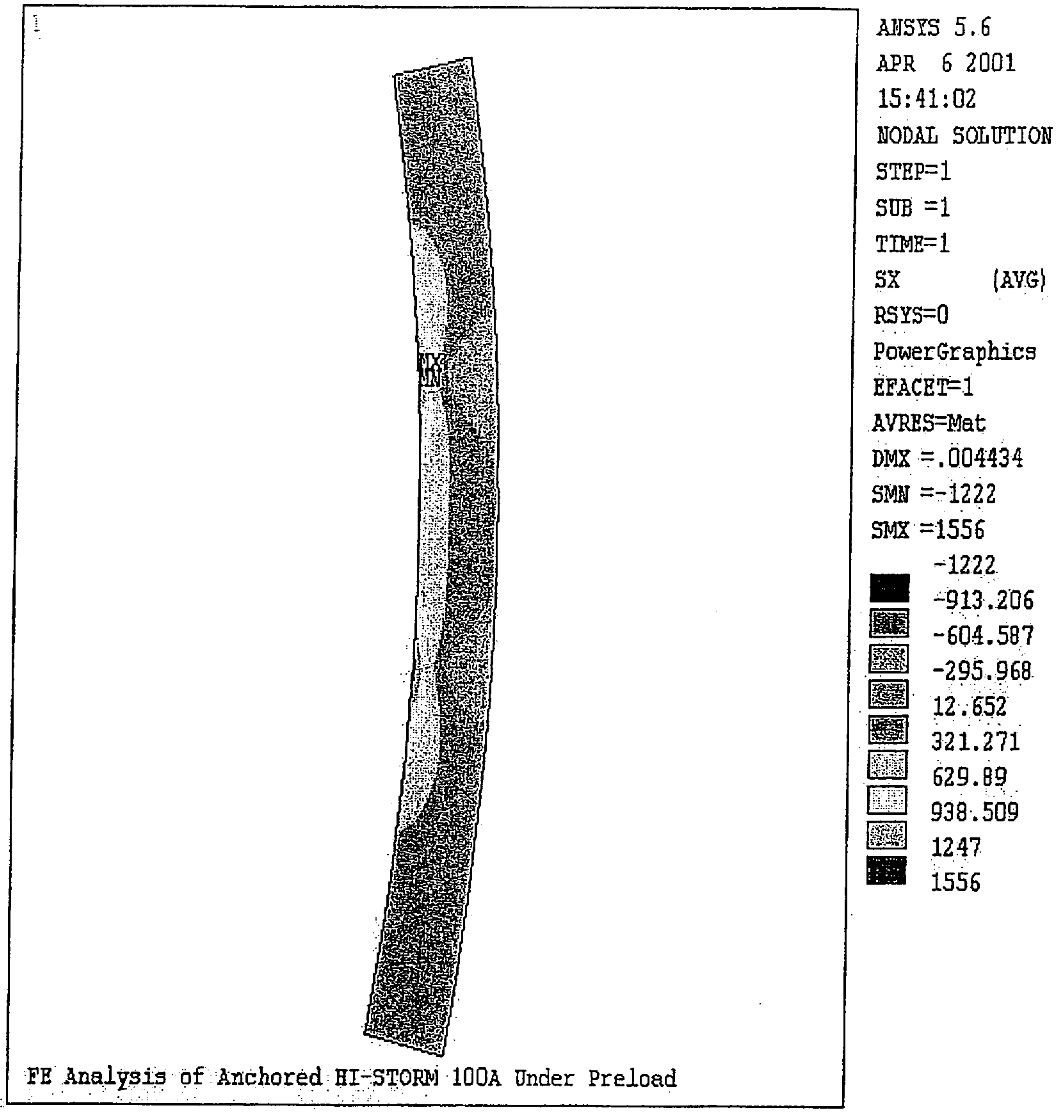


FIGURE 9.11 RADIAL STRESS IN UPPER RING – CASE 1 PRELOAD

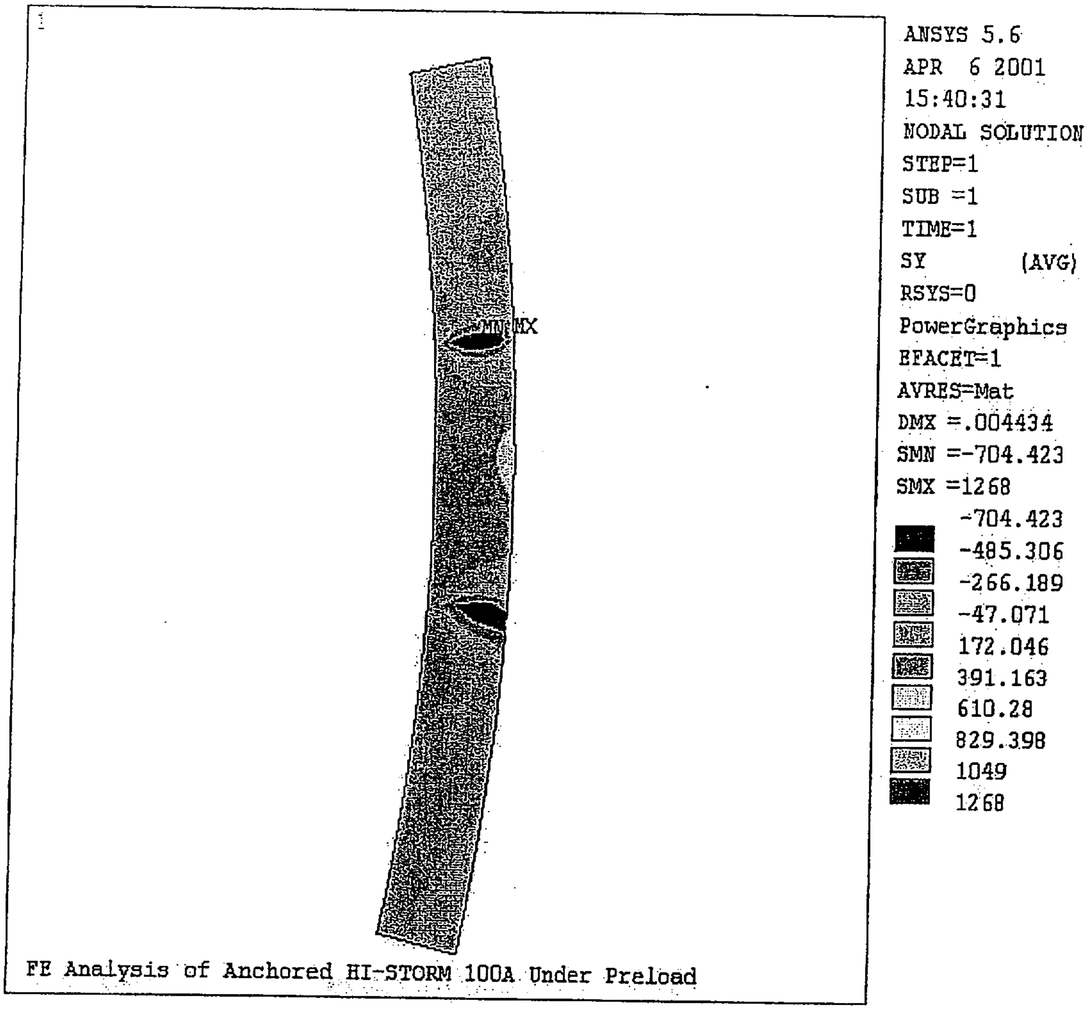


FIGURE 9.12 CIRCUMFERENTIAL STRESS IN UPPER RING – CASE 1 PRELOAD

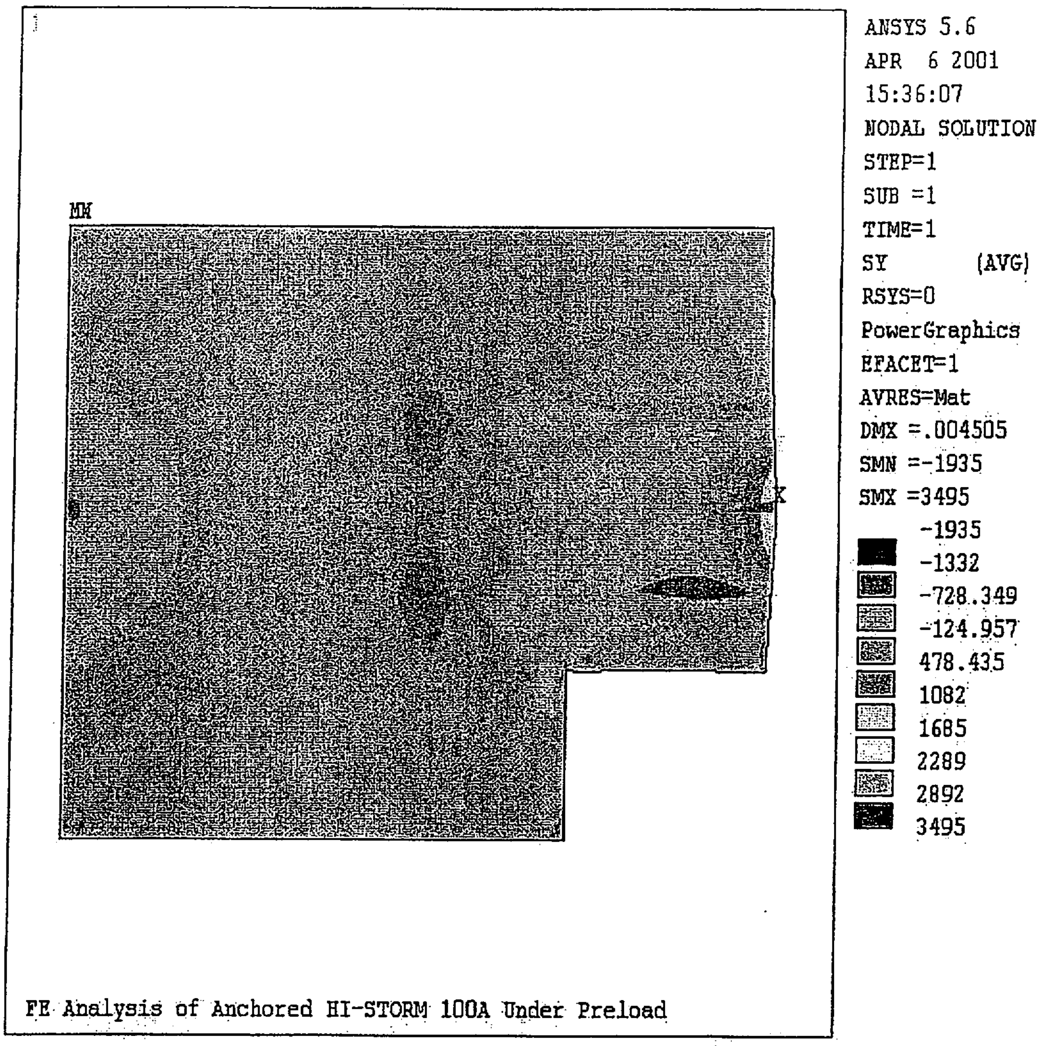


FIGURE 9.13 CIRCUMFERENTIAL STRESS IN HI-STORM SHELL – CASE 1 PRELOAD

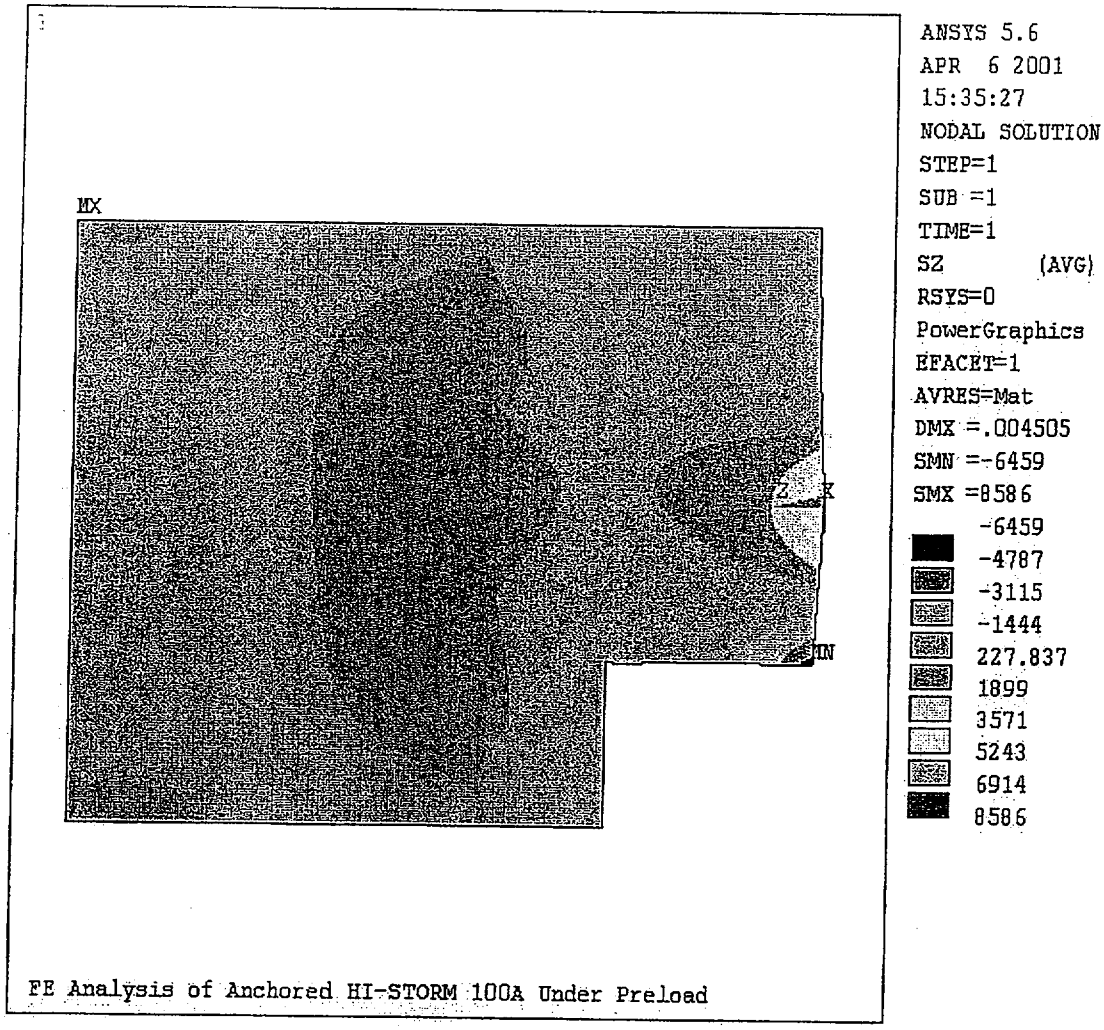


FIGURE 9.14 RADIAL STRESS IN HI-STORM SHELL – CASE 1 PRELOAD

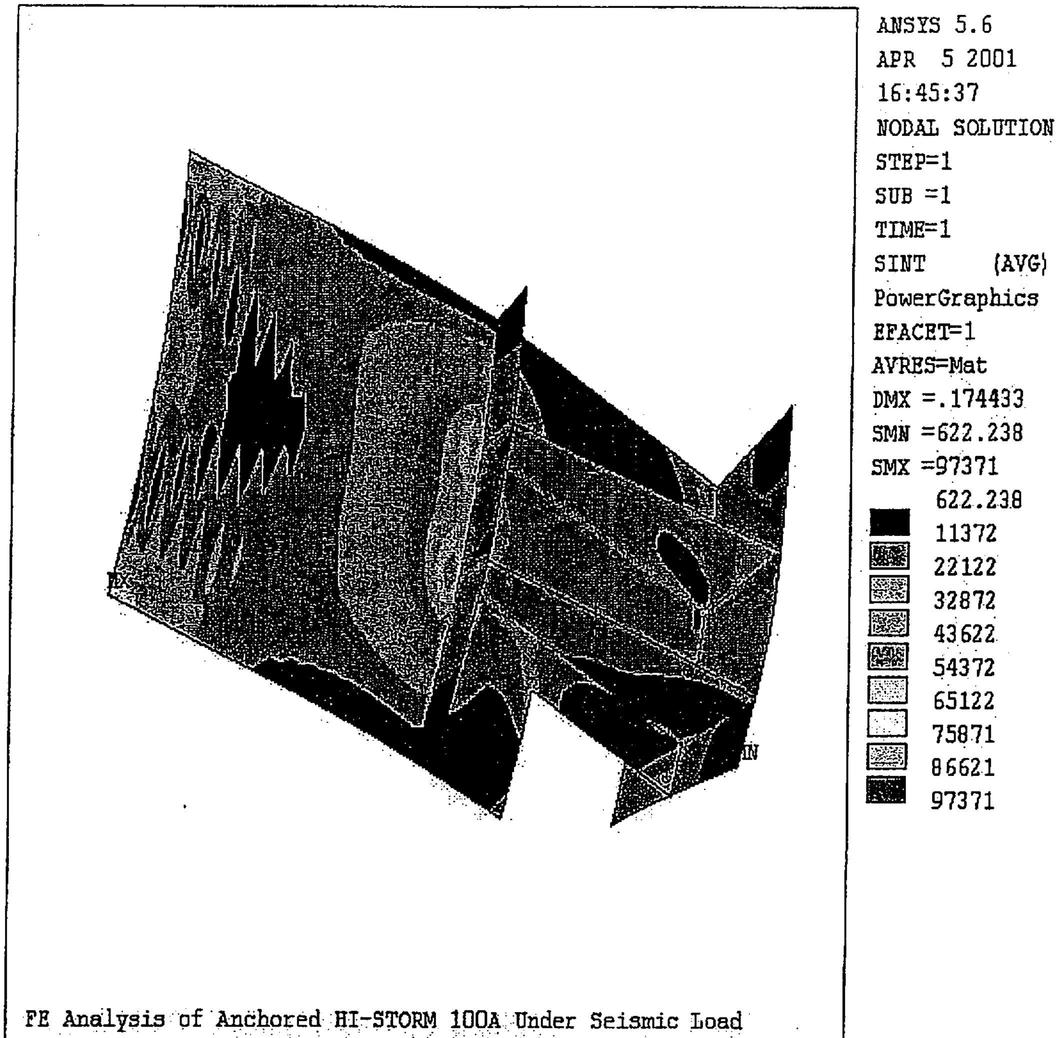


FIGURE 10.1 SECTOR LUG STRESS INTENSITY – CASE 2 MAXIMUM STUD CAPACITY

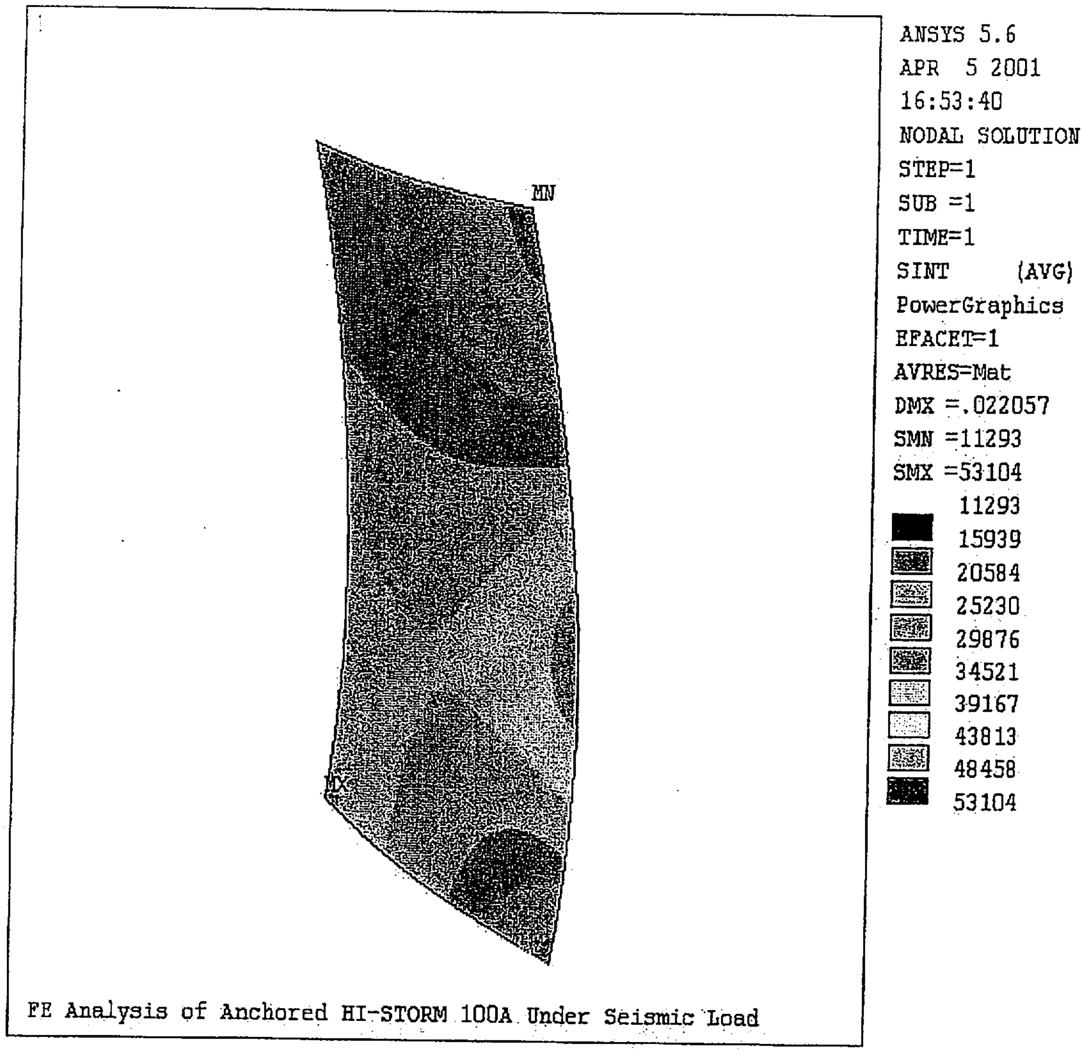


FIGURE 10.2 STRESS INTENSITY IN BASEPLATE – CASE 2 MAXIMUM STUD CAPACITY

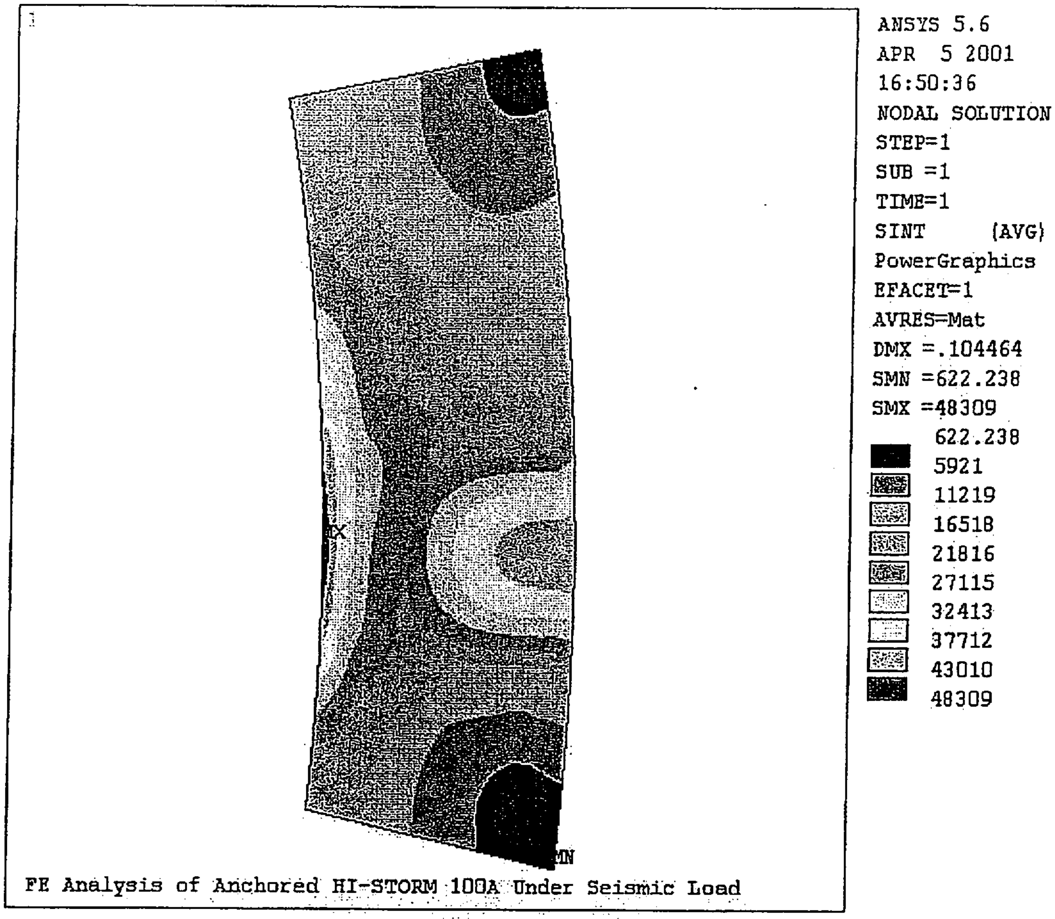


FIGURE 10.3 STRESS INTENSITY IN SECTOR LUG LOWER ANNULAR RING – CASE 2 MAXIMUM STUD CAPACITY

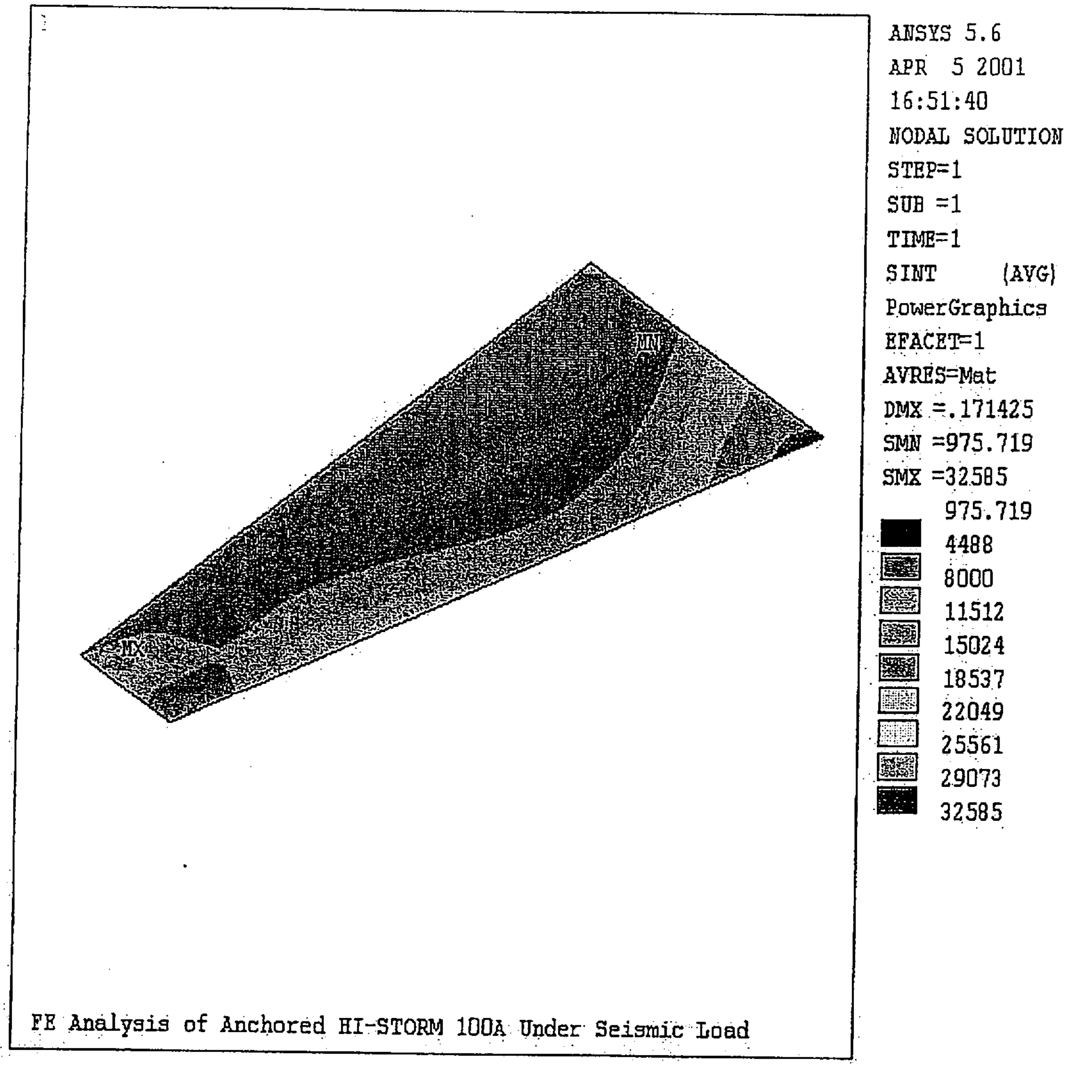


FIGURE 10.4 STRESS INTENSITY IN SECTOR LUG LEFT GUSSET – CASE 2 MAXIMUM STUD CAPACITY

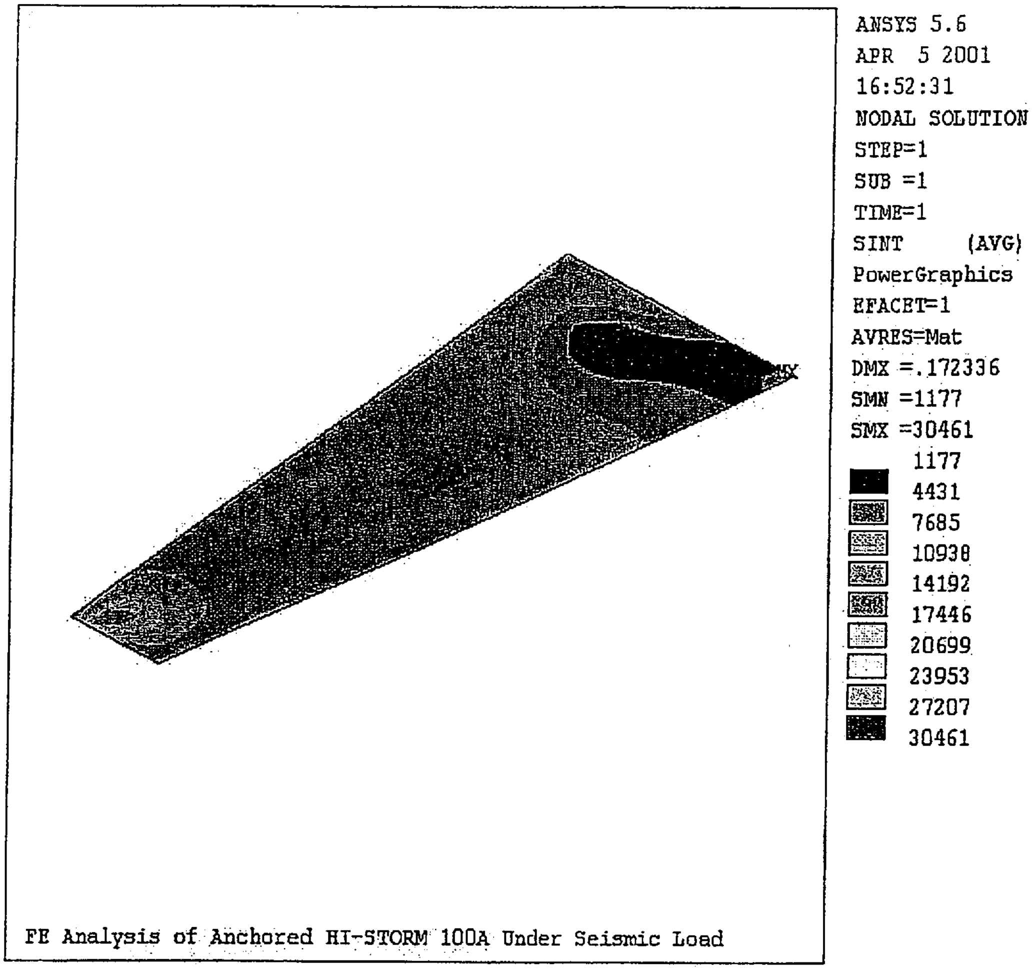


FIGURE 10.5 STRESS INTENSITY IN SECTOR LUG RIGHT GUSSET – CASE 2 MAXIMUM STUD CAPACITY

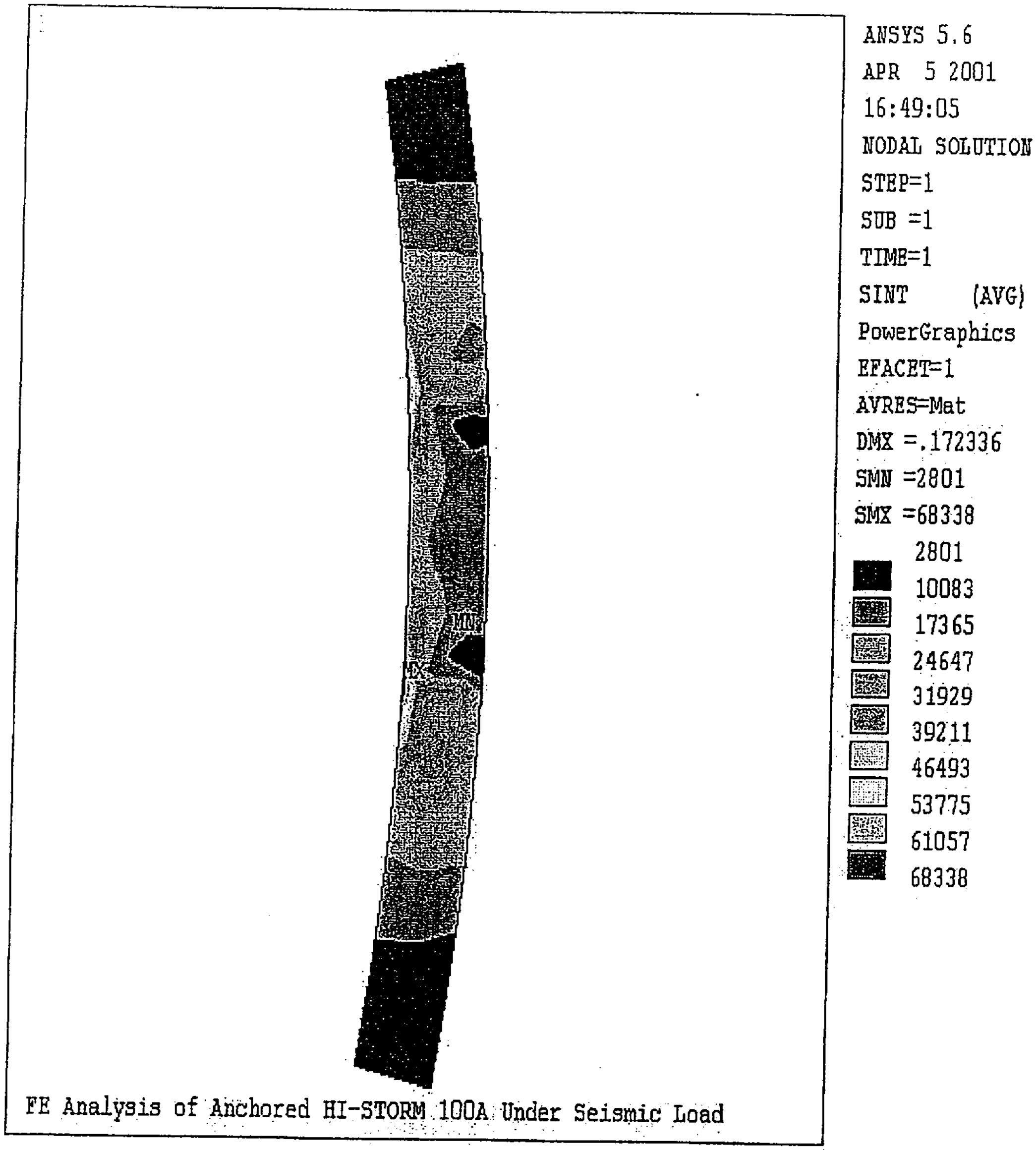


FIGURE 10.6 STRESS INTENSITY IN SECTOR LUG UPPER RING – CASE 2 MAXIMUM STUD CAPACITY

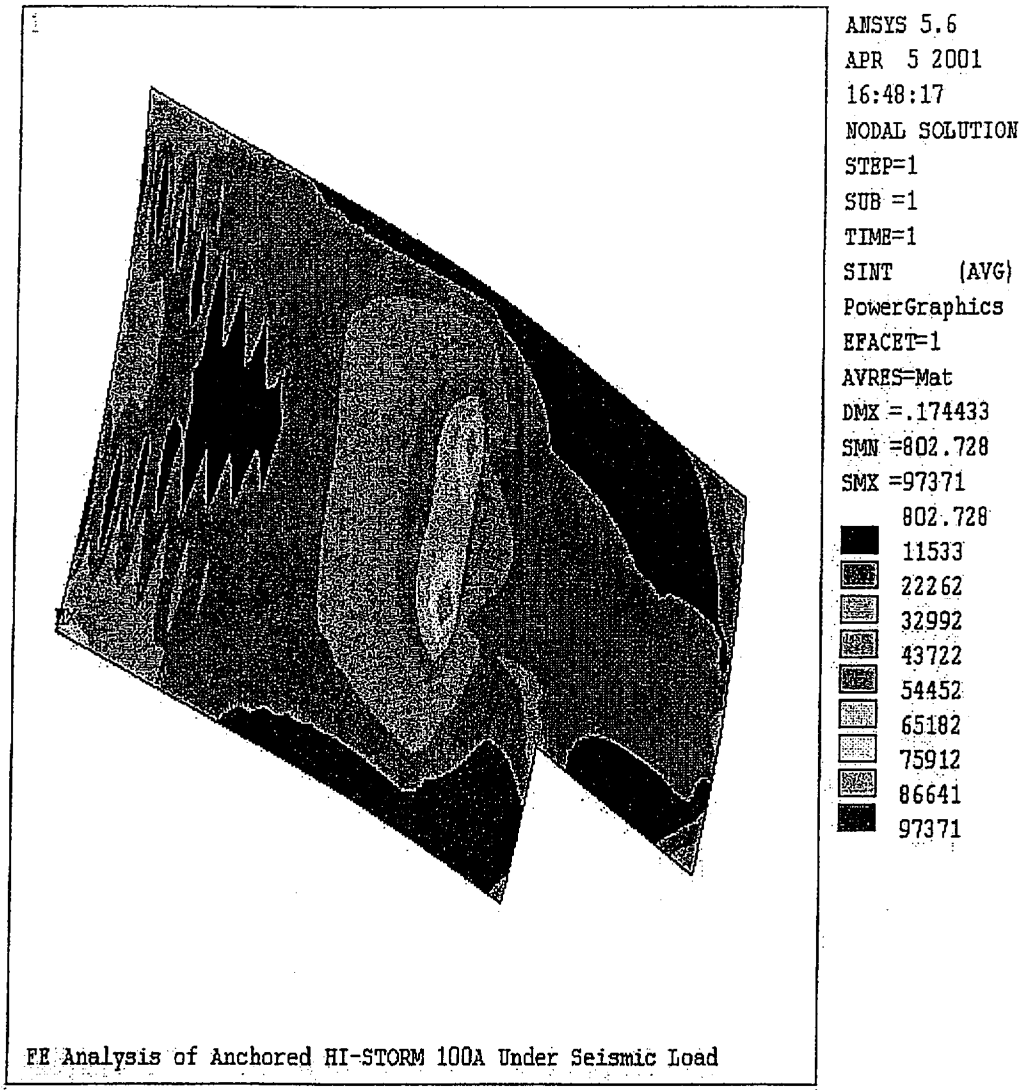


FIGURE 10.7 STRESS INTENSITY IN HI-STORM SHELL – CASE 2 MAXIMUM STUD CAPACITY

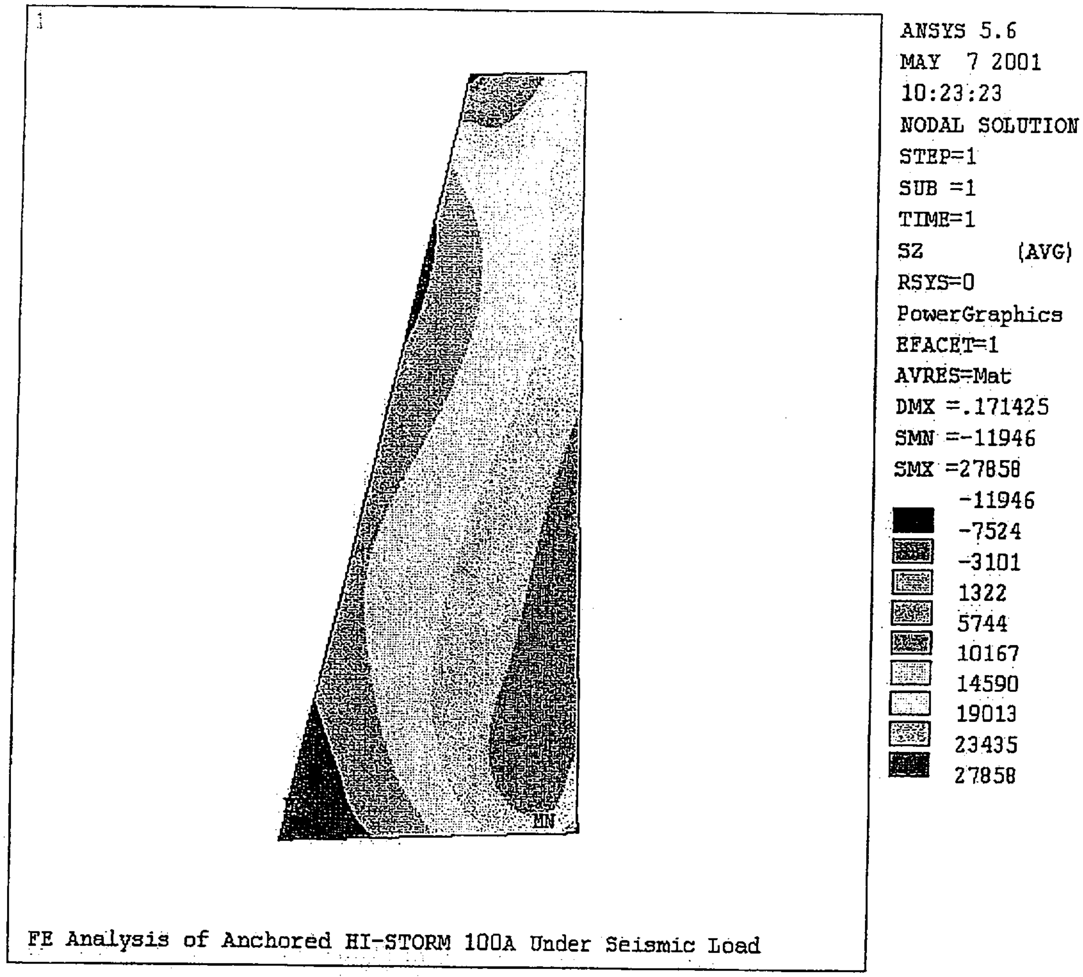


FIGURE 10.8 SZ STRESS-STUD SIDE OF LEFT GUSSET – CASE 2 MAXIMUM STUD CAPACITY

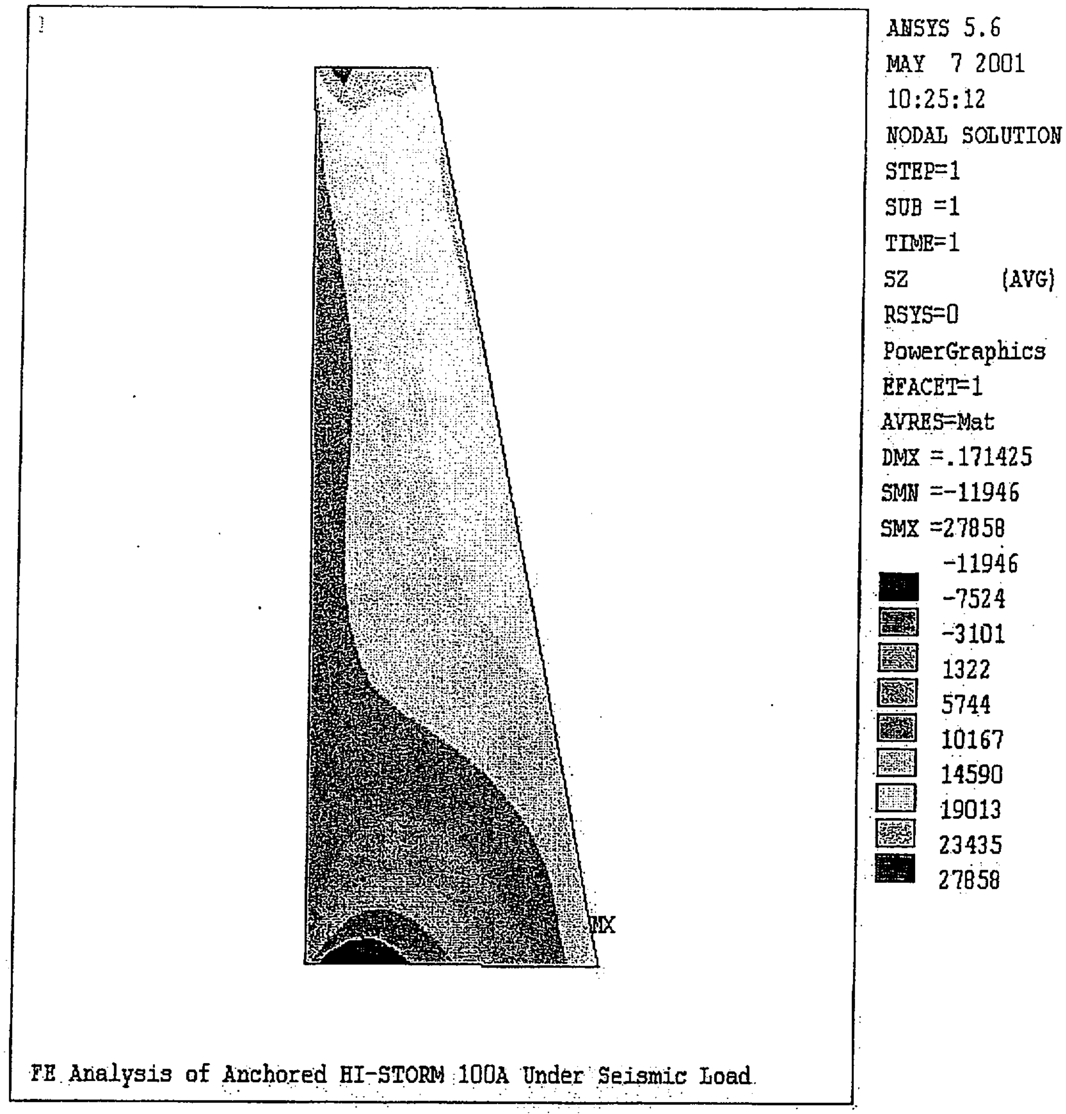


FIGURE 10.9 SZ STRESS-INLET AIR DUCT SIDE OF LEFT GUSSET – CASE 2 MAXIMUM STUD CAPACITY

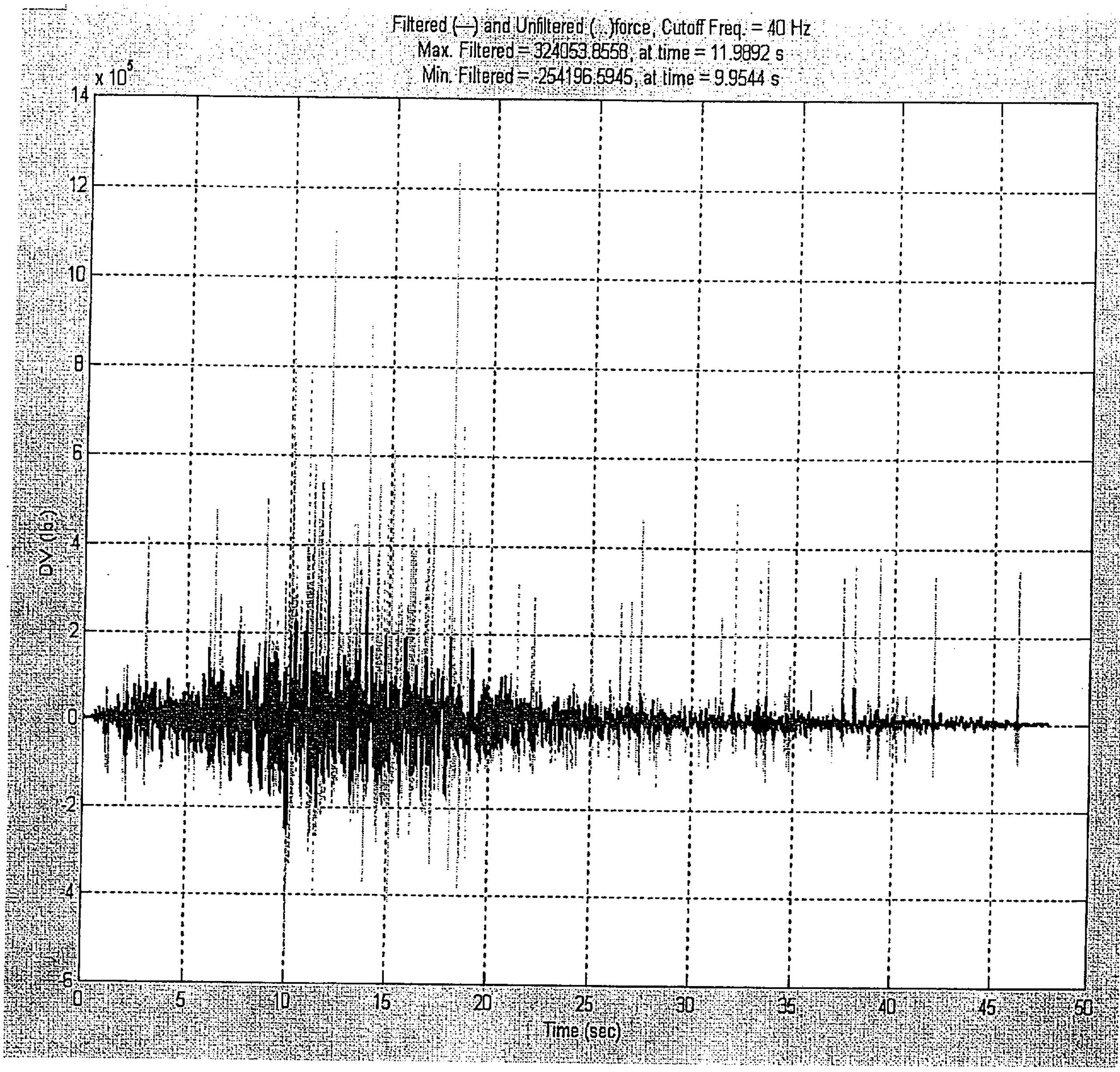


FIGURE 11 COMPRESSIVE FORCE AT INTERFACE (Unfiltered and Filtered) – LTSP SEISMIC EVENT

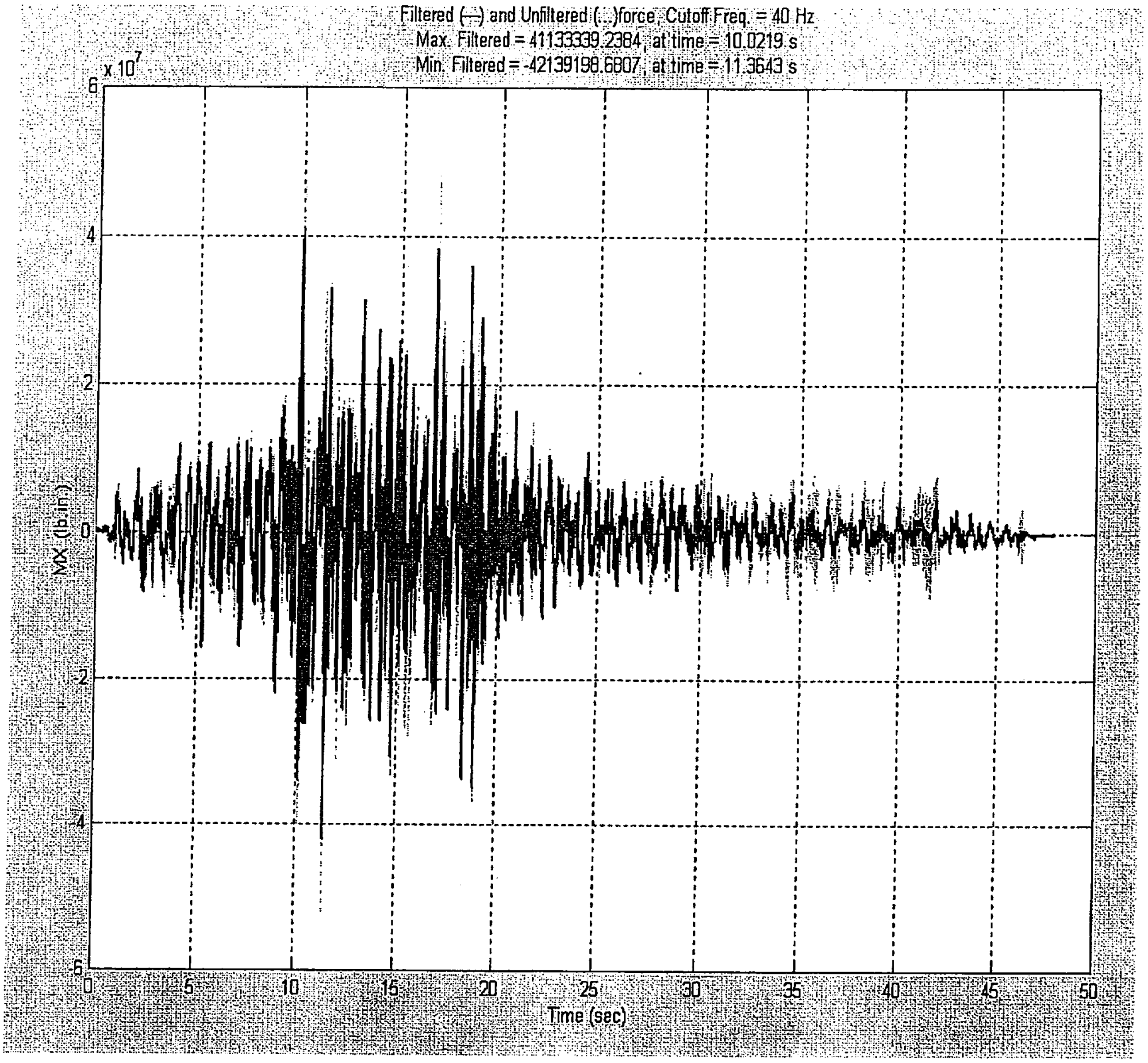


FIGURE 12 MOMENT "MX" AT INTERFACE (Unfiltered and Filtered) – LTSP SEISMIC EVENT

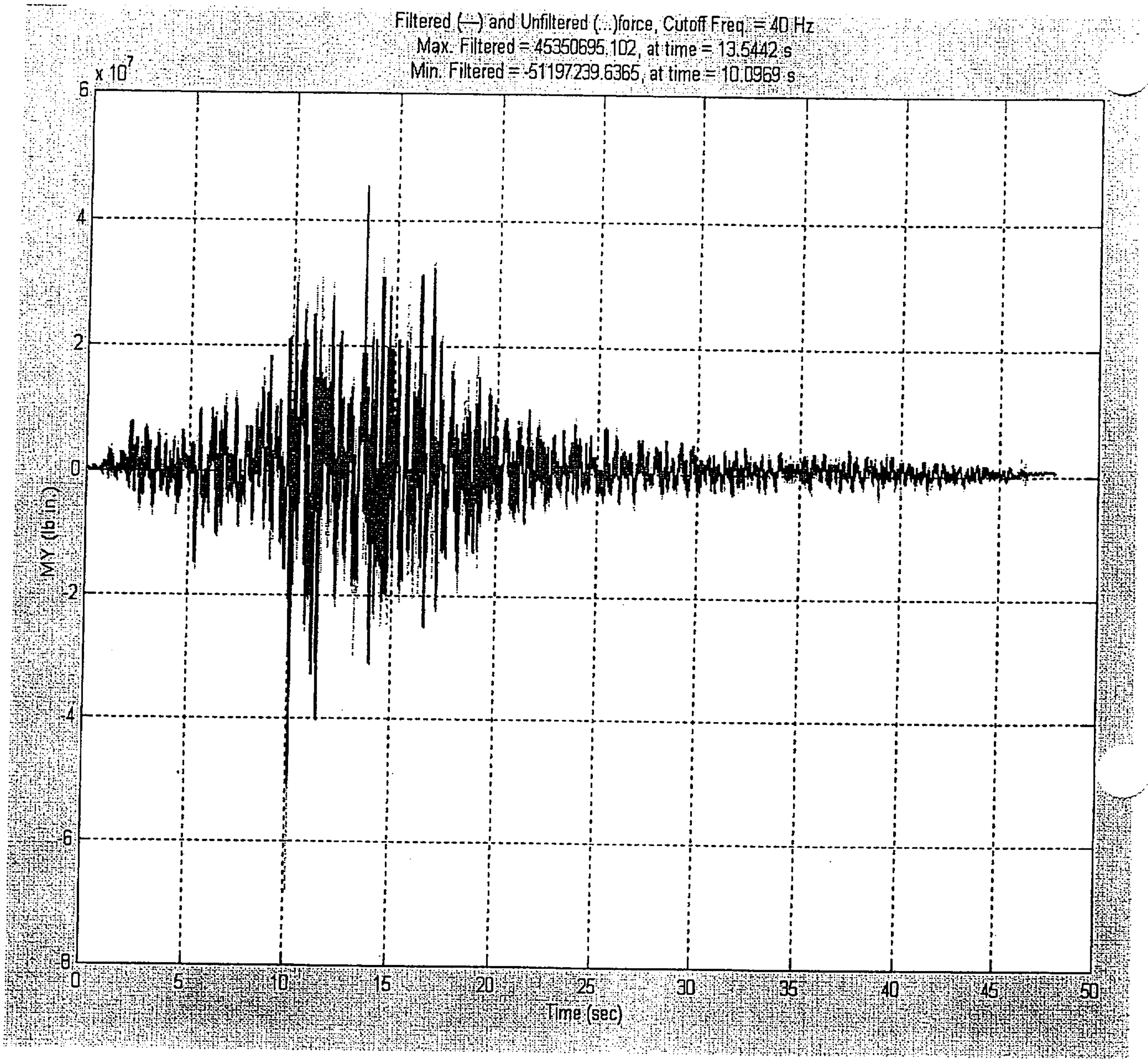


FIGURE 13 MOMENT "MY" AT INTERFACE (Unfiltered and Filtered) – LTSP SEISMIC EVENT

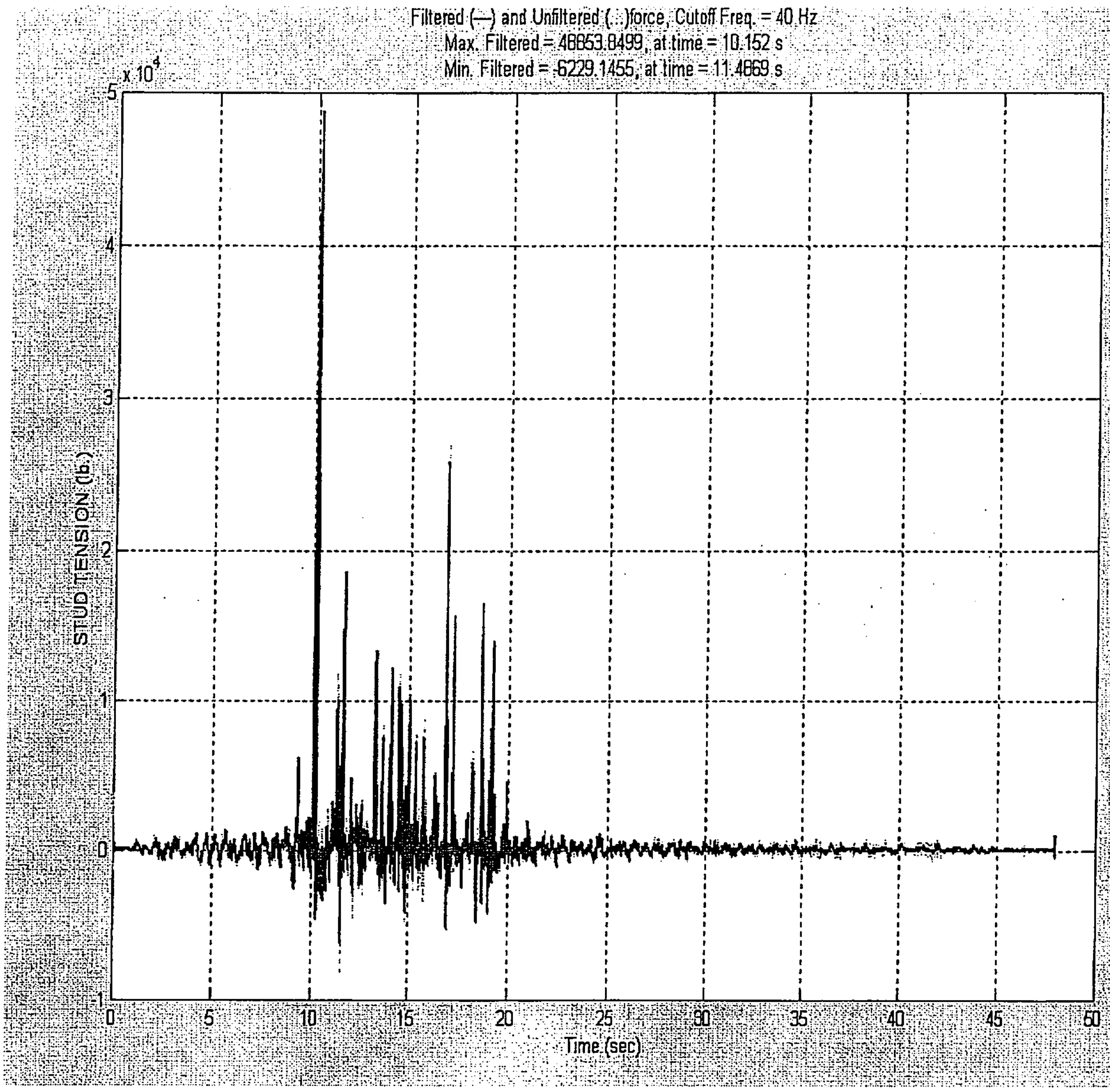


FIGURE 14 TENSILE FORCE IN ANCHOR ROD 26 (Unfiltered and Filtered) – LTSP SEISMIC EVENT

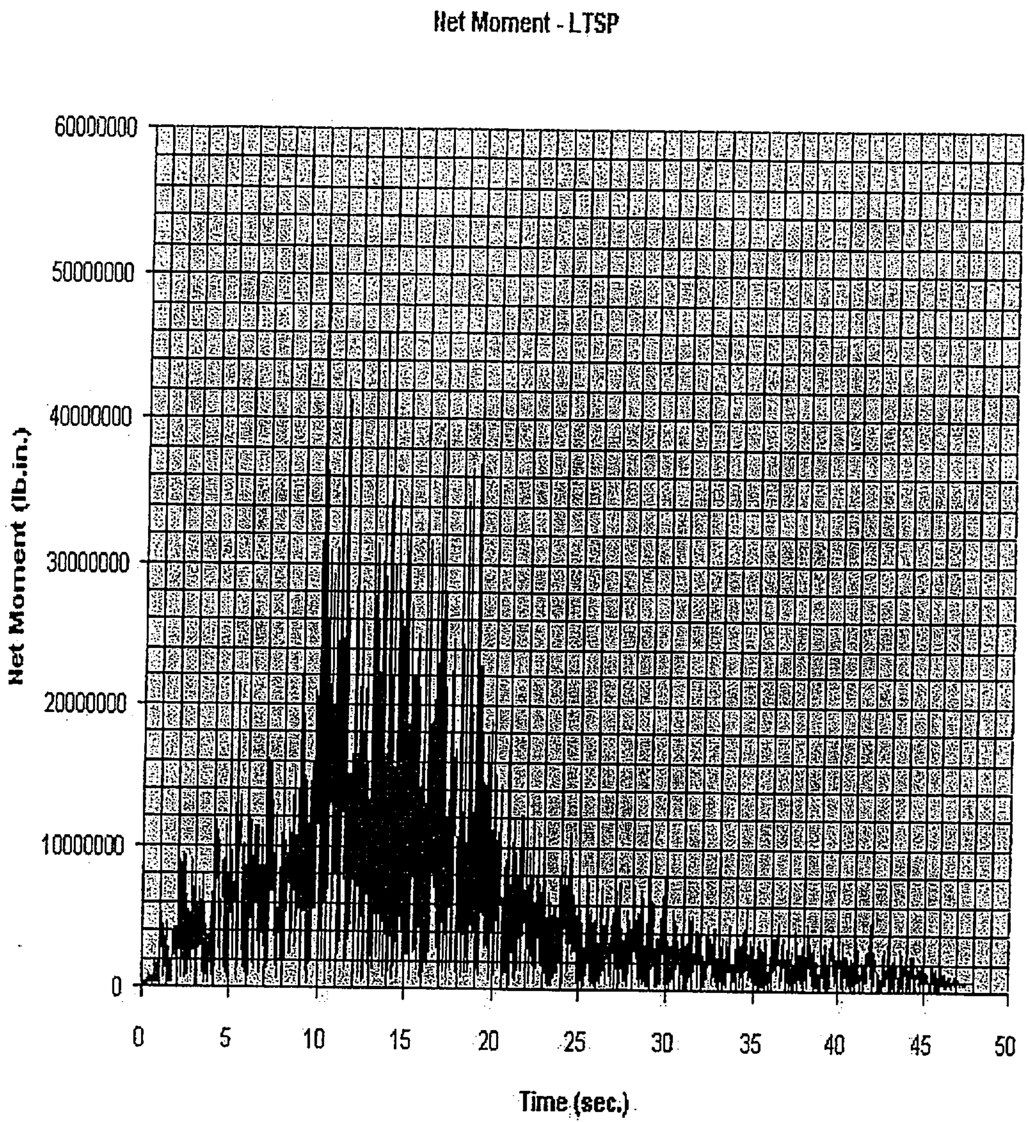


FIGURE 15 NET OVERTURNING MOMENT – LTSP SEISMIC EVENT

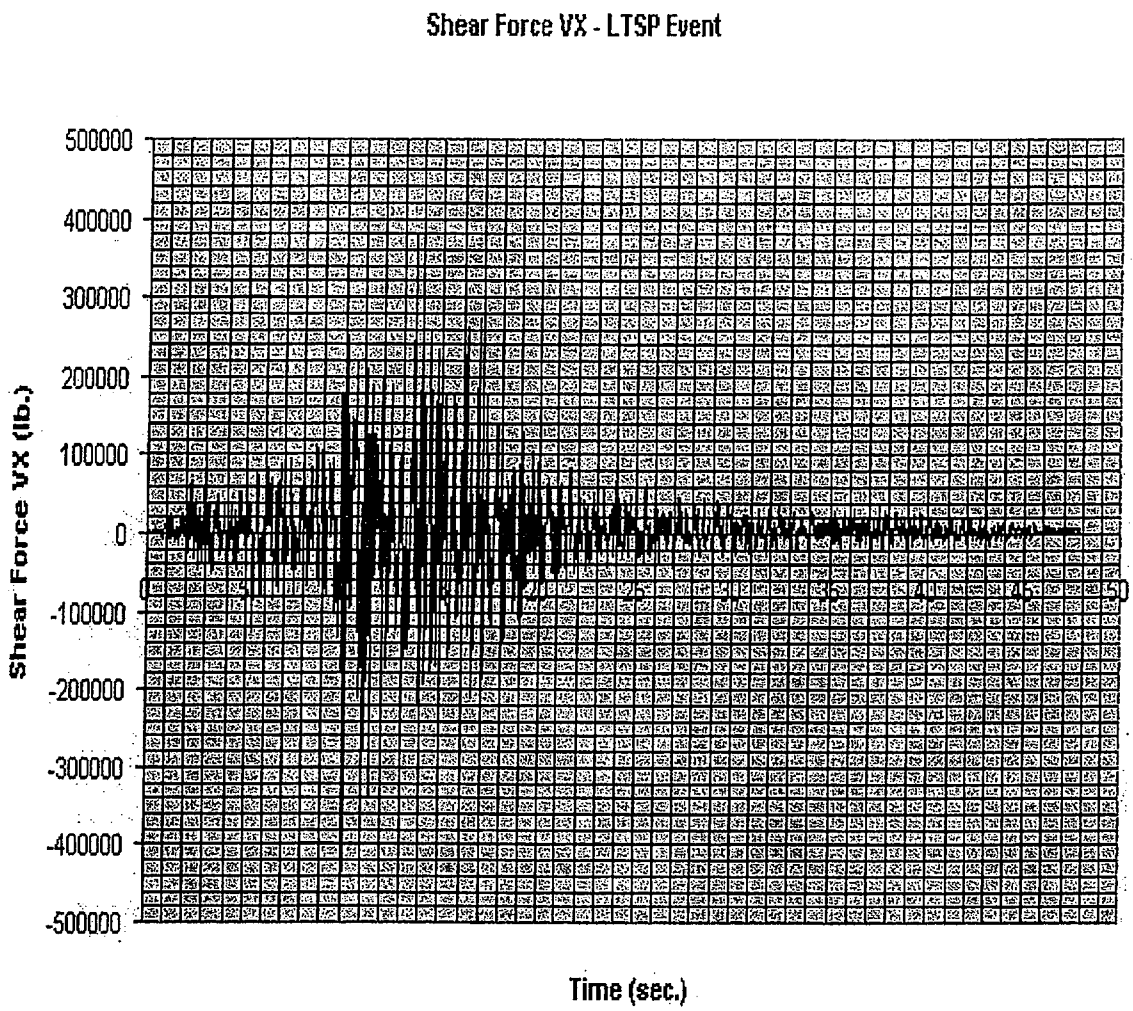


FIGURE 16 SHEAR "VX" AT INTERFACE – LTSP SEISMIC EVENT

Shear Force VY - LTSP Event

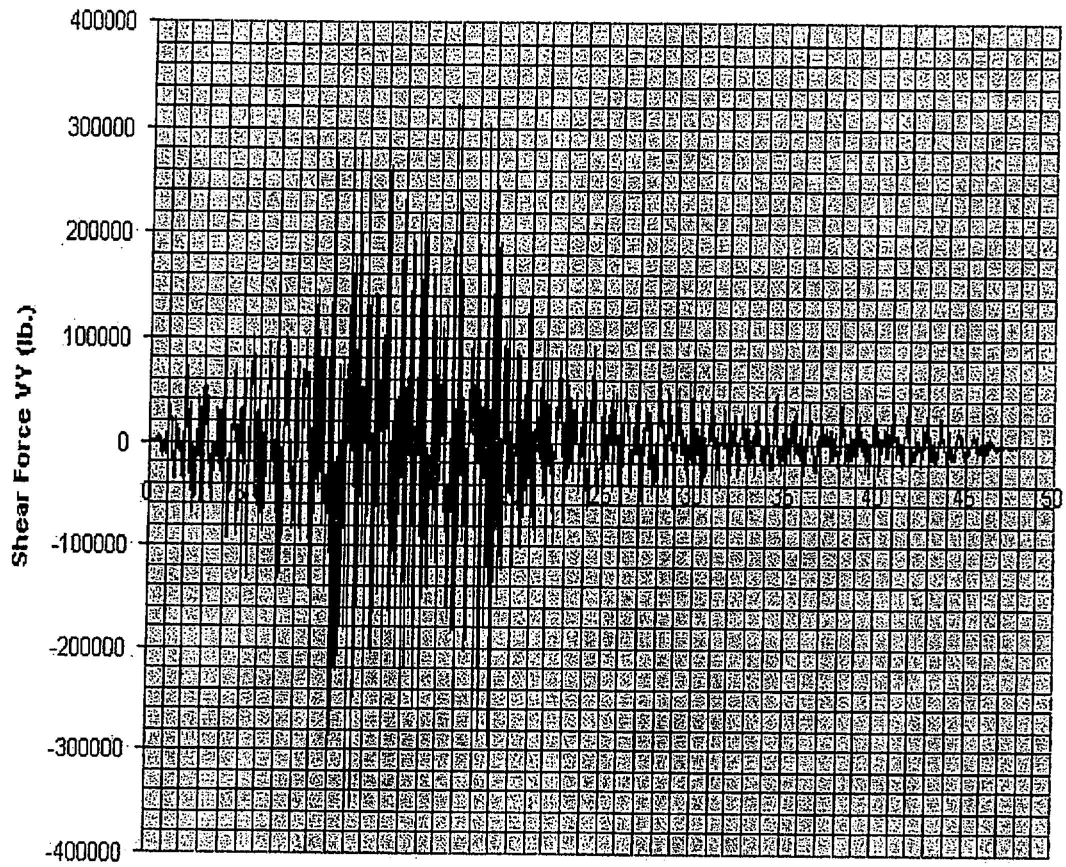


FIGURE 17 SHEAR "VY" AT INTERFACE (Unfiltered and Filtered) – LTSP SEISMIC EVENT

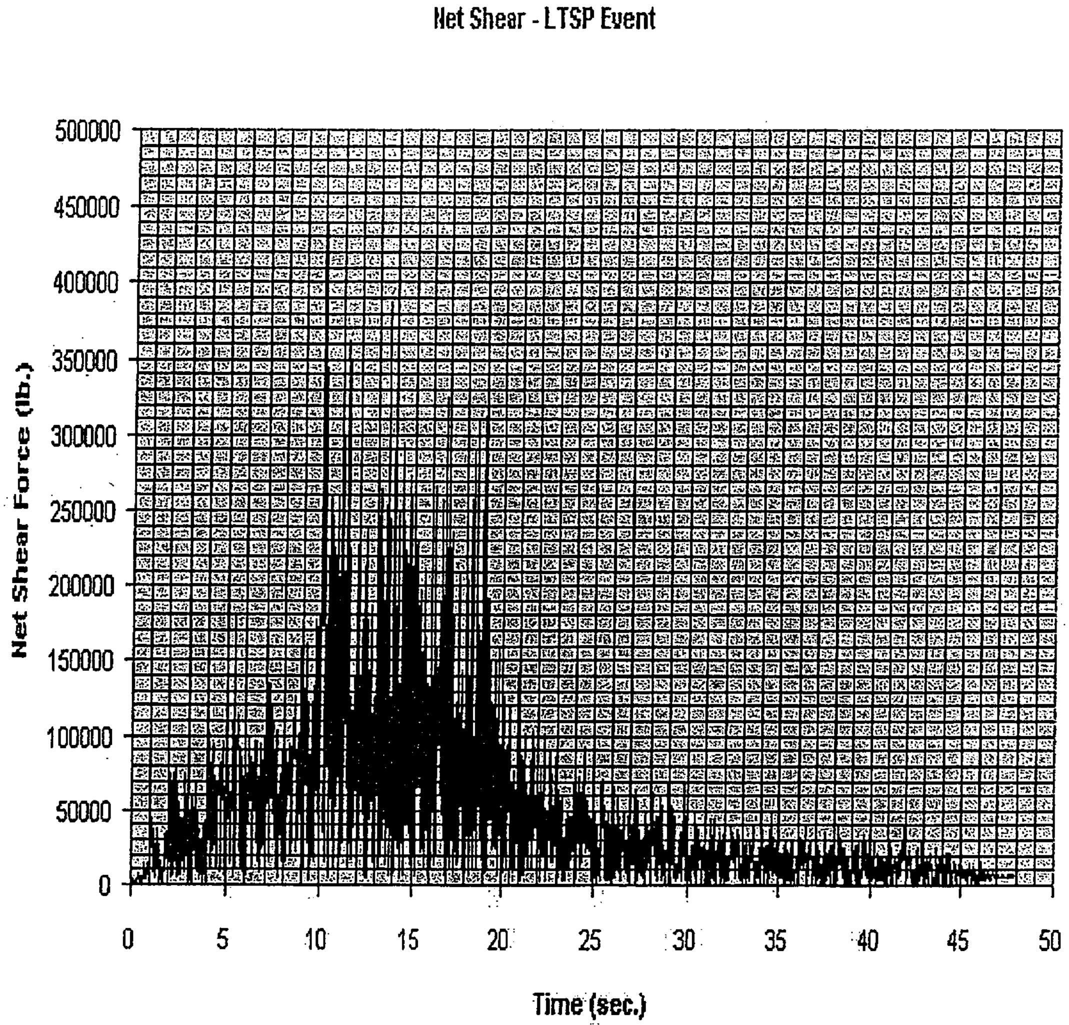


FIGURE 18 NET SHEAR FORCE – LTSP SEISMIC EVENT

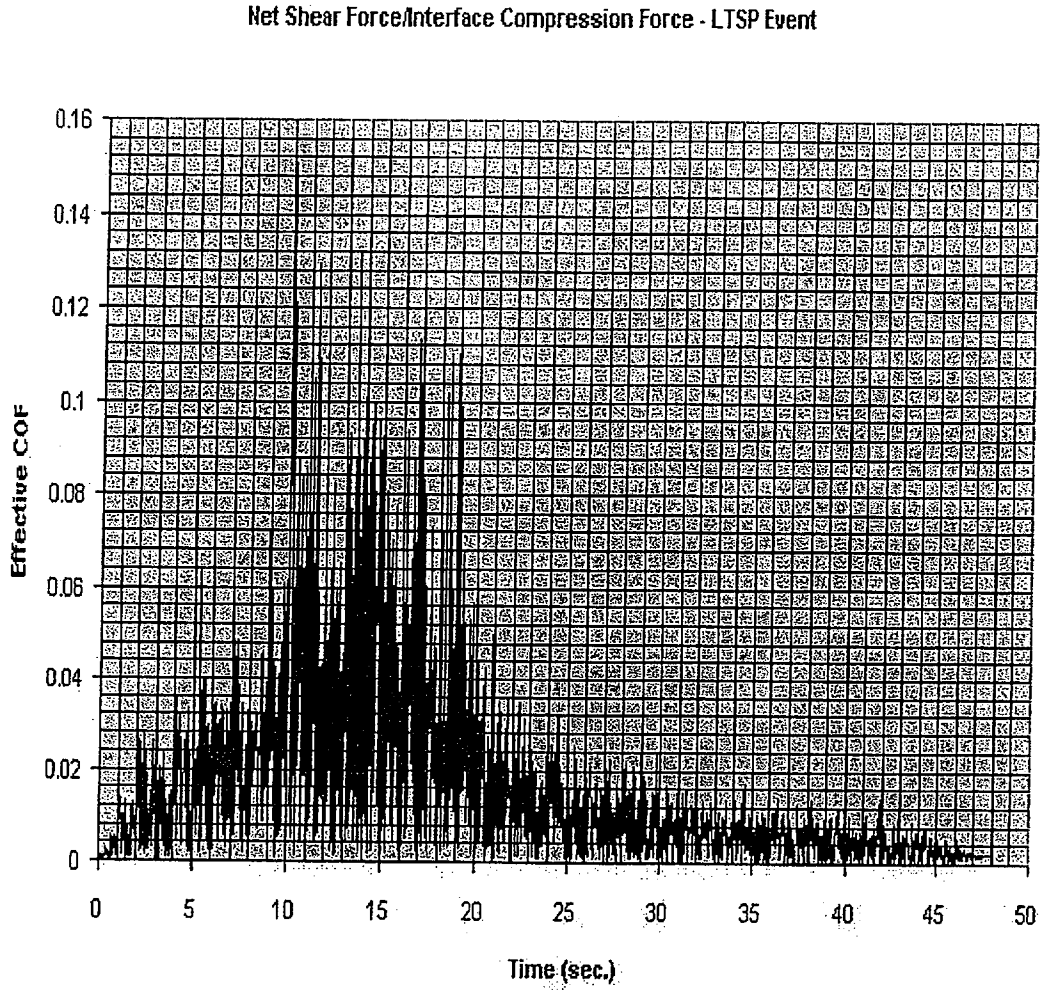


FIGURE 19 EFFECTIVE COEFFICIENT OF FRICTION – LTSP SEISMIC EVENT

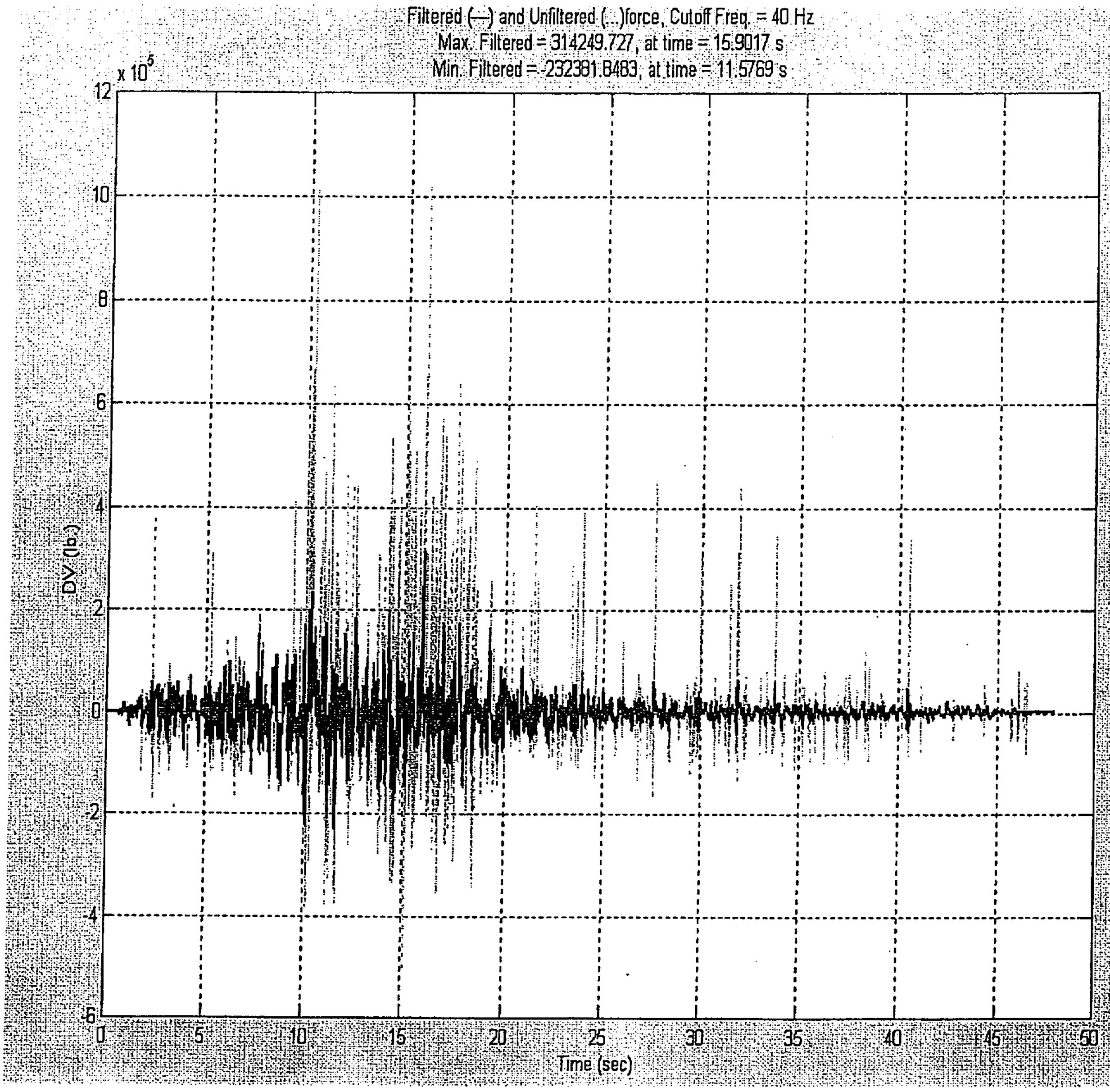


FIGURE 20 COMPRESSIVE FORCE INCREMENT AT INTERFACE (Unfiltered and Filtered) – HE SEISMIC EVENT

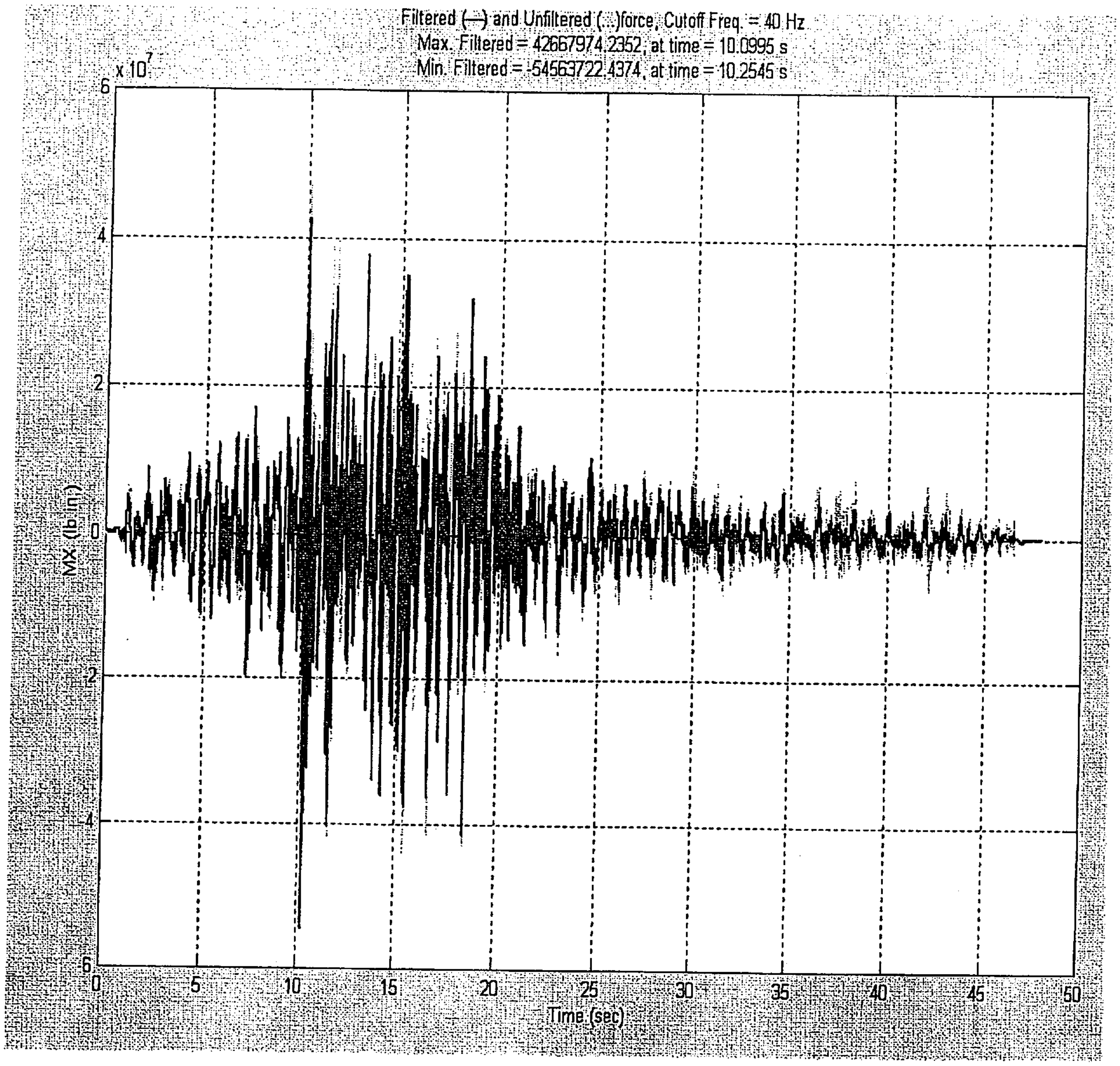


FIGURE 21 MOMENT "MX" AT INTERFACE (Unfiltered and Filtered) – HE SEISMIC EVENT

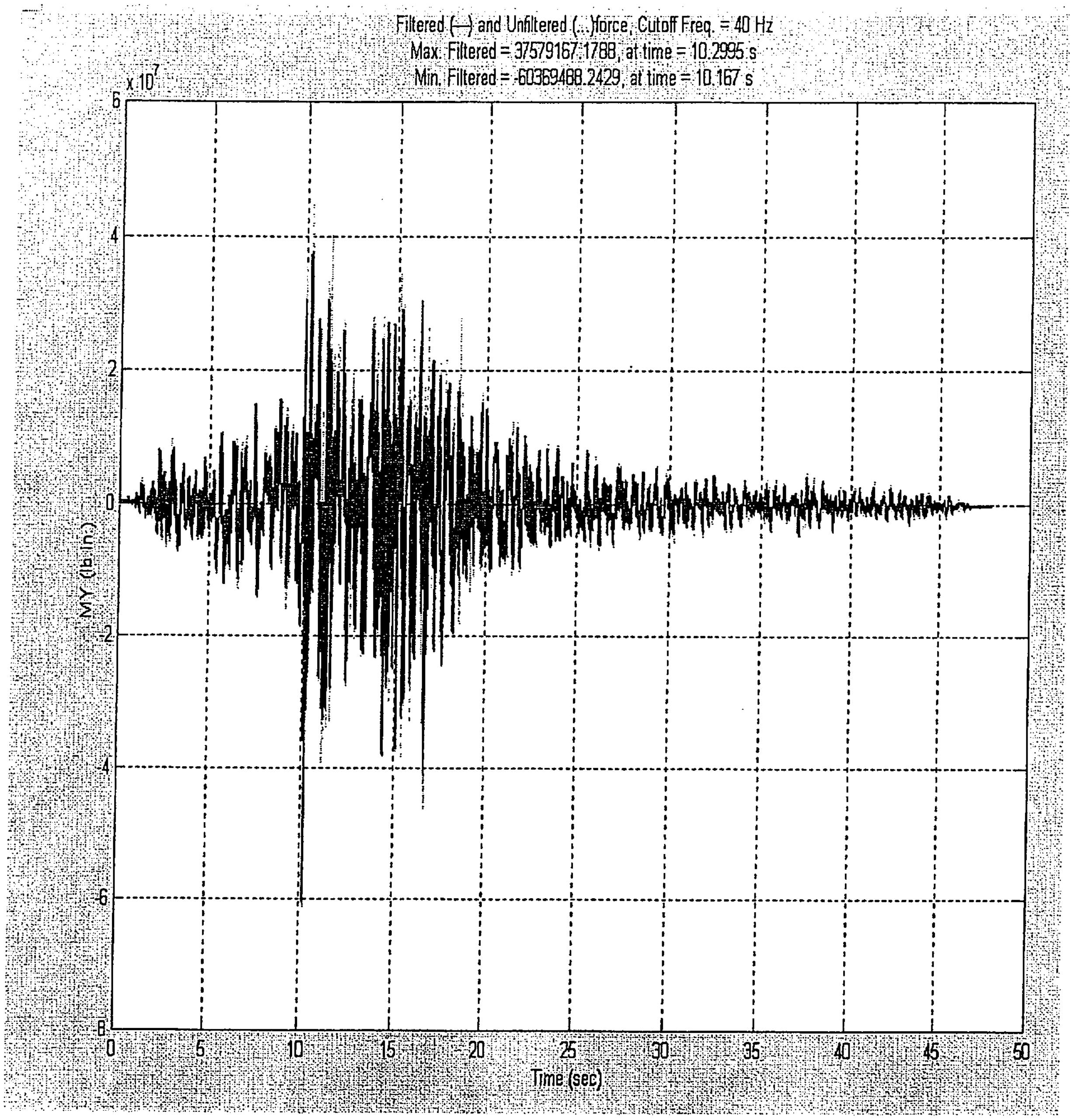


FIGURE 22 MOMENT "MY" AT INTERFACE (Unfiltered and Filtered) – HE SEISMIC EVENT

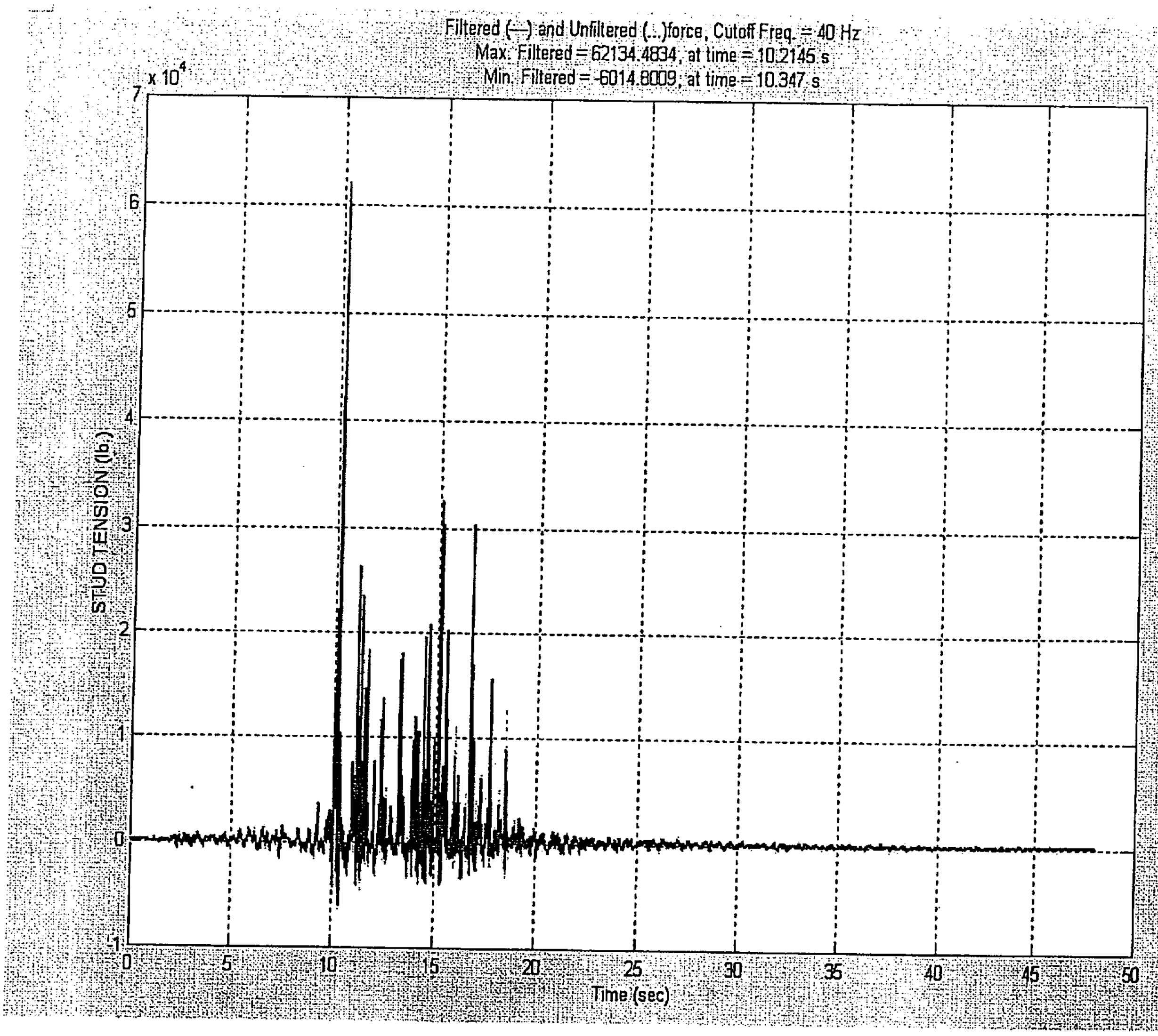


FIGURE 23 TENSILE FORCE IN ANCHOR ROD 11 – HE SEISMIC EVENT

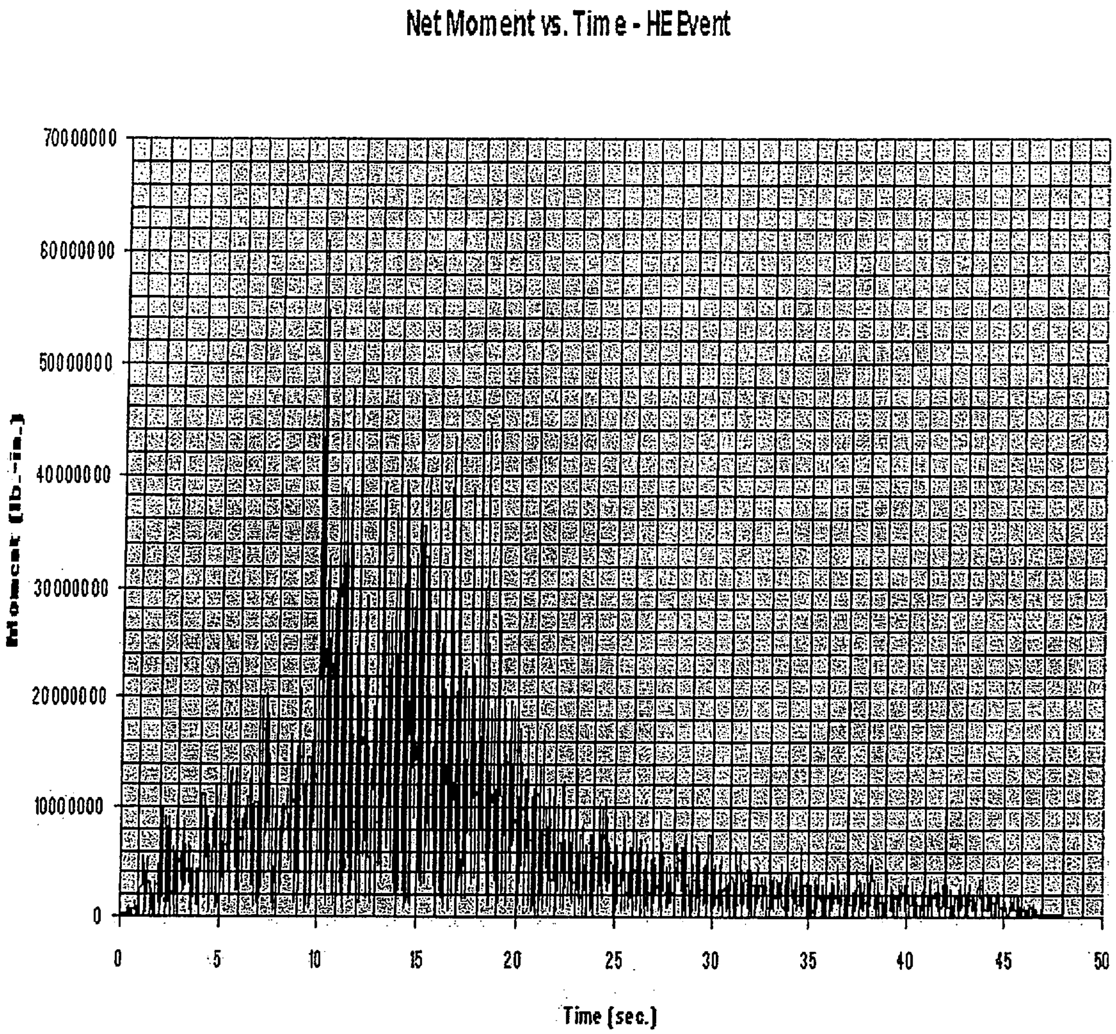


FIGURE 24 NET MOMENT – HE SEISMIC EVENT

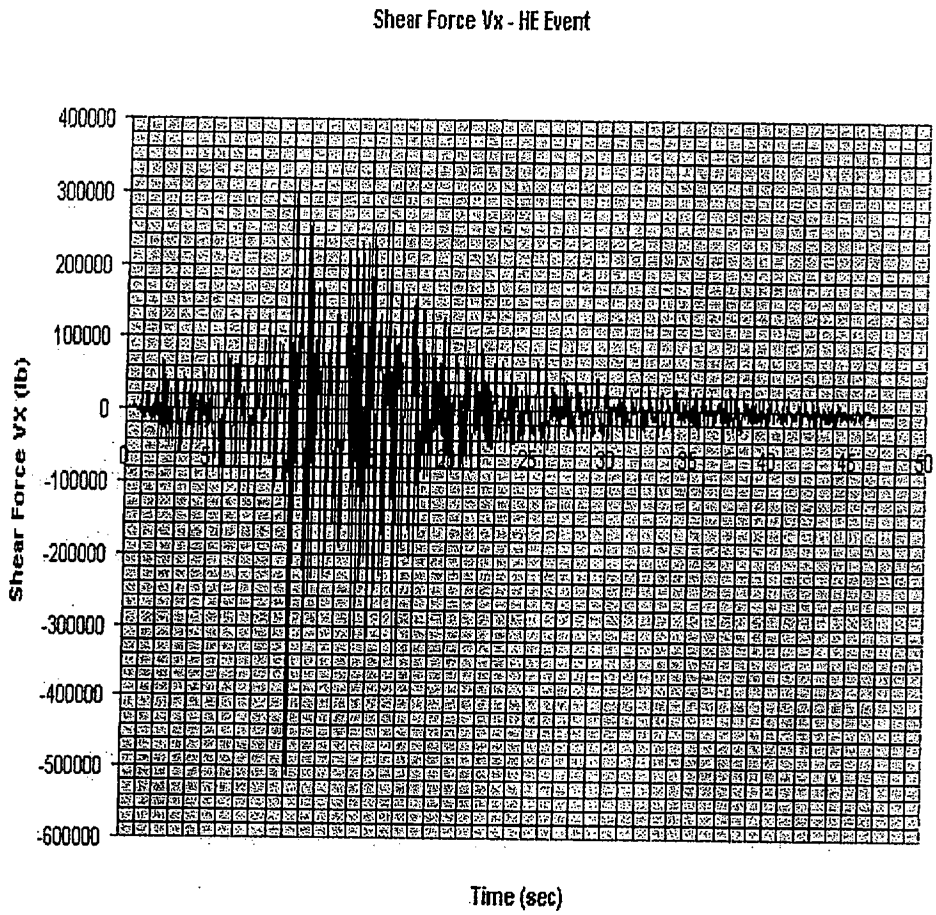


FIGURE 25 SHEAR "VX" AT INTERFACE – HE SEISMIC EVENT

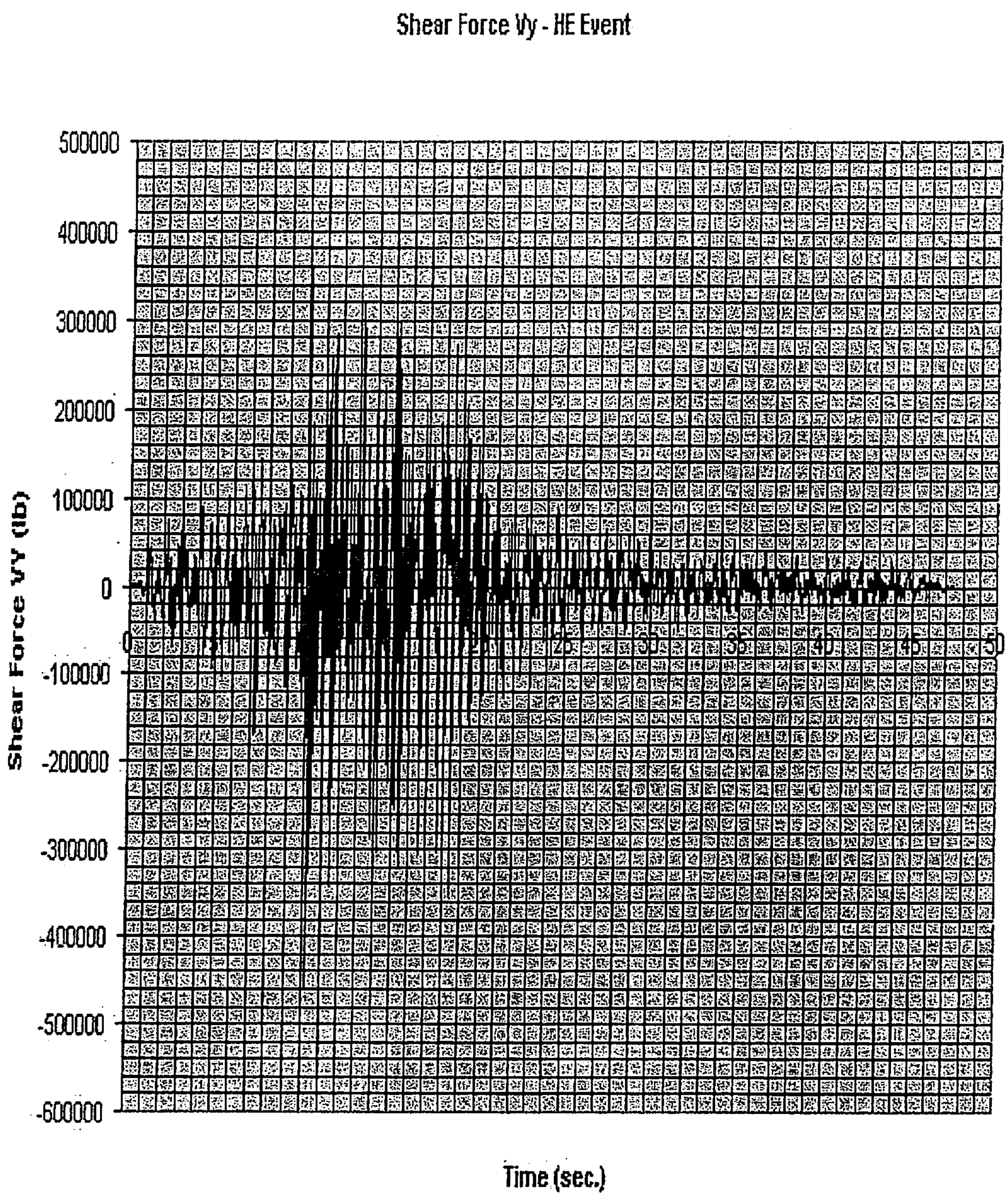


FIGURE 26 SHEAR "VY" AT INTERFACE – HE SEISMIC EVENT

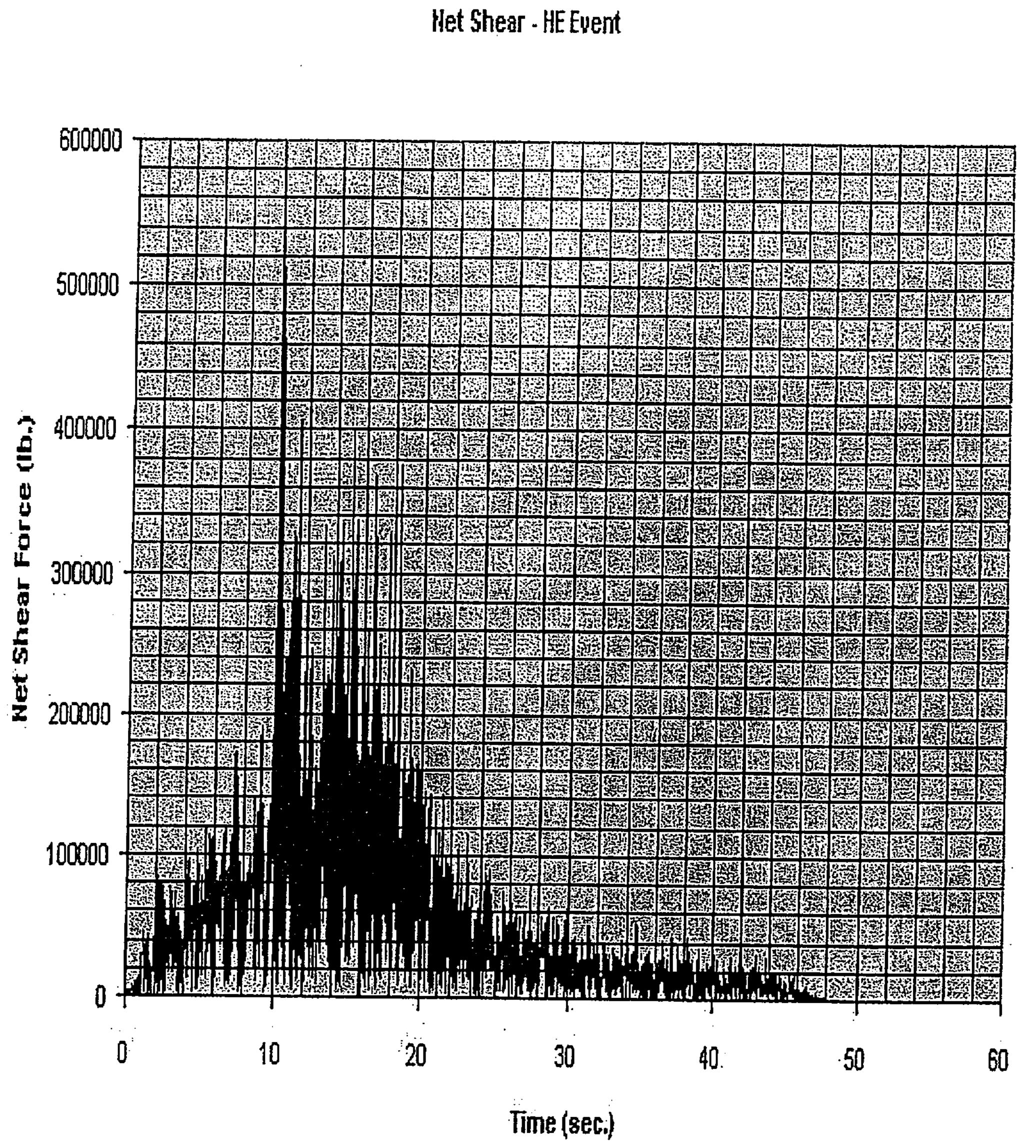


FIGURE 27 NET SHEAR FORCE - HE SEISMIC EVENT

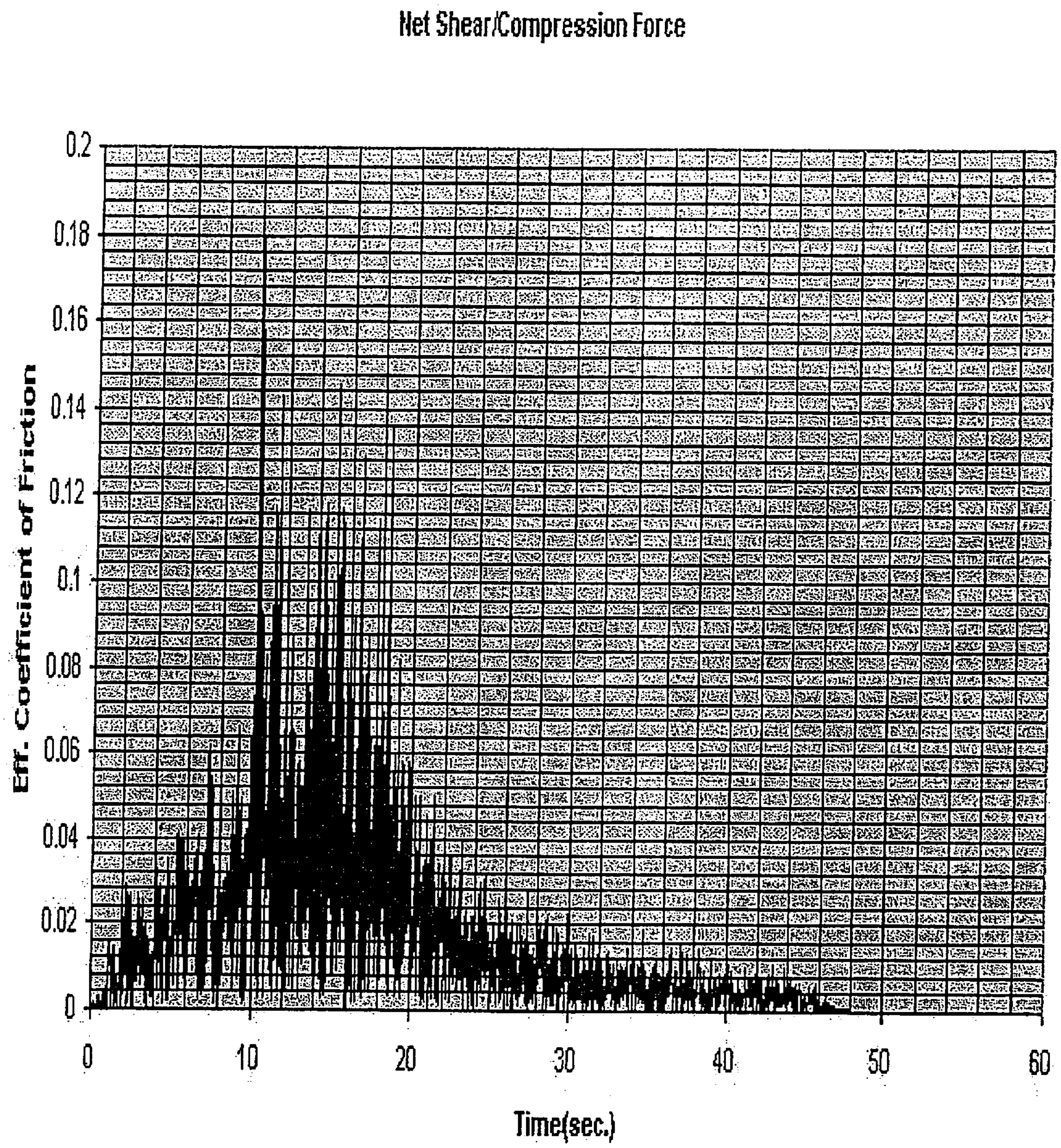


FIGURE 28 EFFECTIVE COEFFICIENT OF FRICTION - HE SEISMIC EVENT

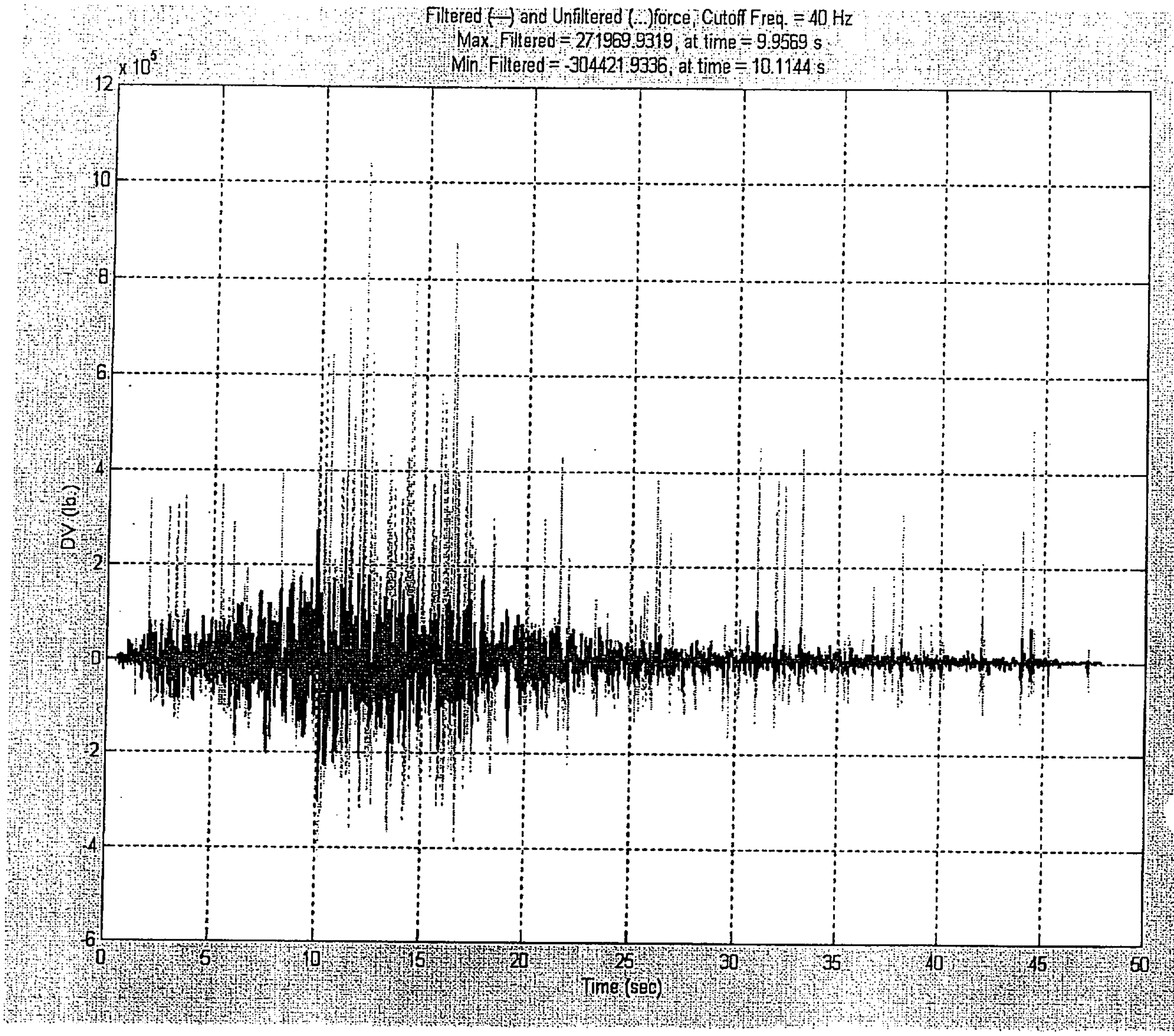


FIGURE 29 COMPRESSIVE FORCE INCREMENT AT INTERFACE (Unfiltered and Filtered) – LTSP SEISMIC EVENT - NEGATIVE VT

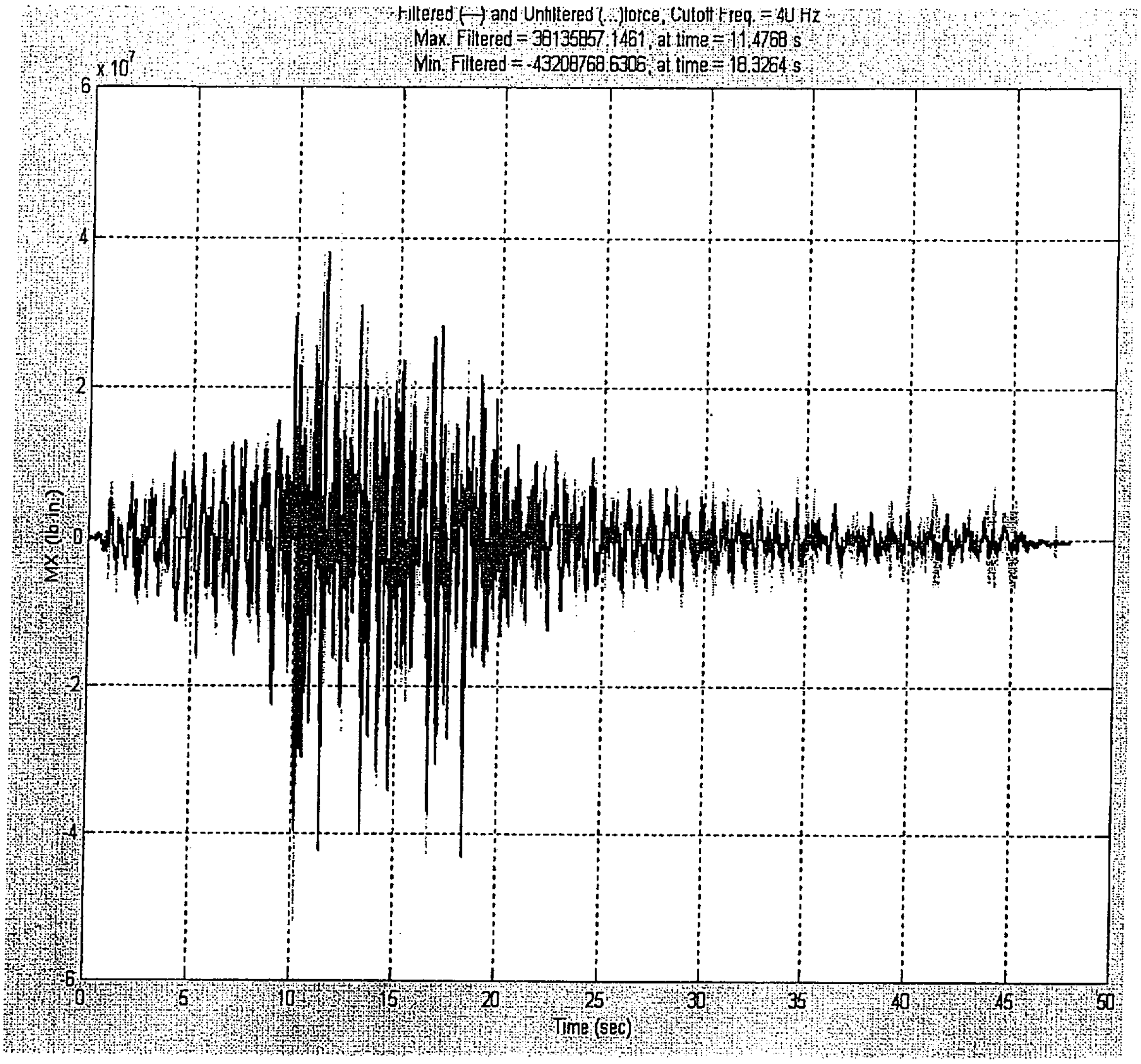


FIGURE 30 – MOMENT MX AT EMBED/CONCRETE INTERFACE – LTSP SEISMIC EVENT –NEGATIVE VT EARTHQUAKE

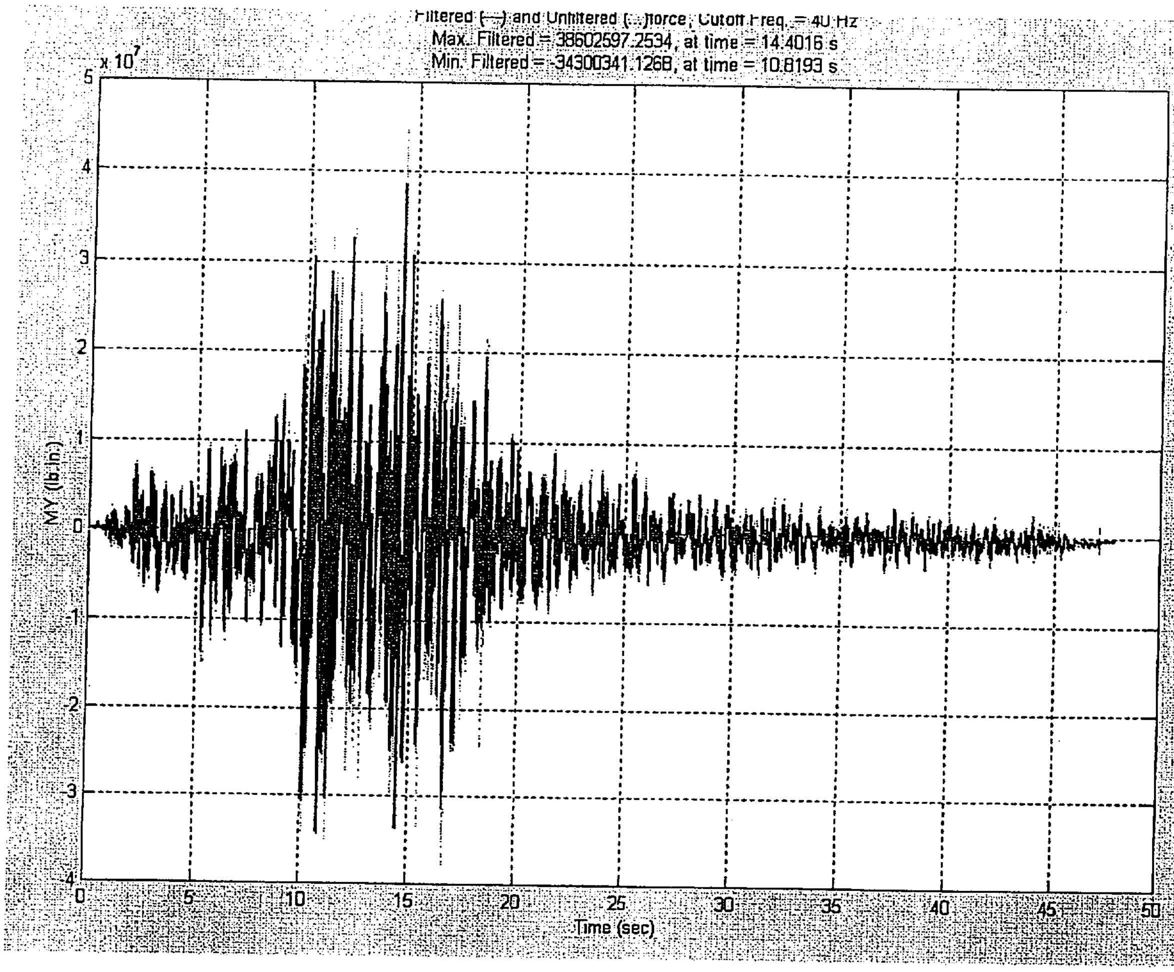


FIGURE 31 – MOMENT MY AT EMBED/CONCRETE INTERFACE – LTSP SEISMIC EVENT NEGATIVE VT EARTHQUAKE

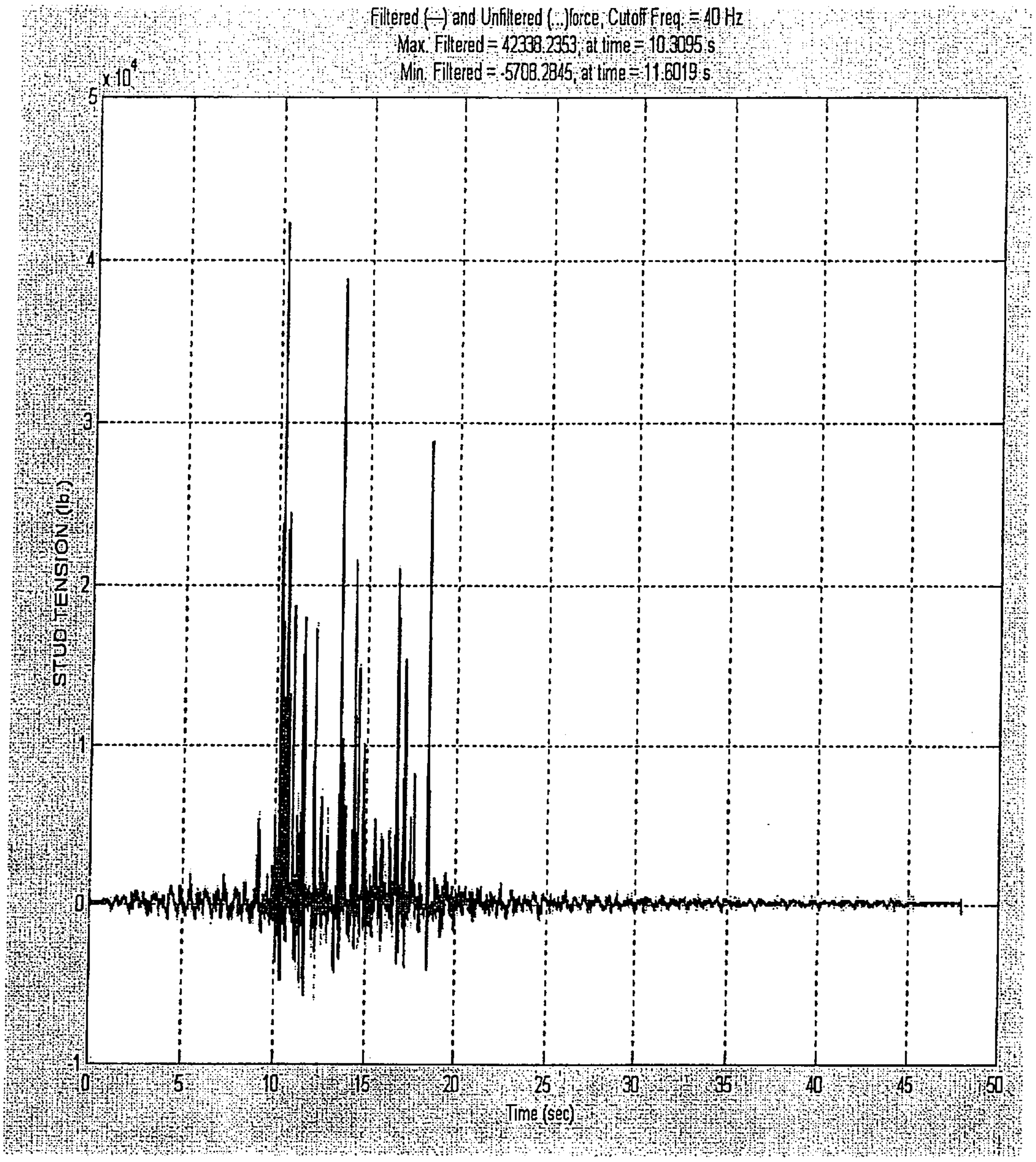


FIGURE 32 – ANCHOR ROD 22 TENSION AT EMBED/CONCRETE INTERFACE – LTSP SEISMIC EVENT –NEGATIVE VT EARTHQUAKE

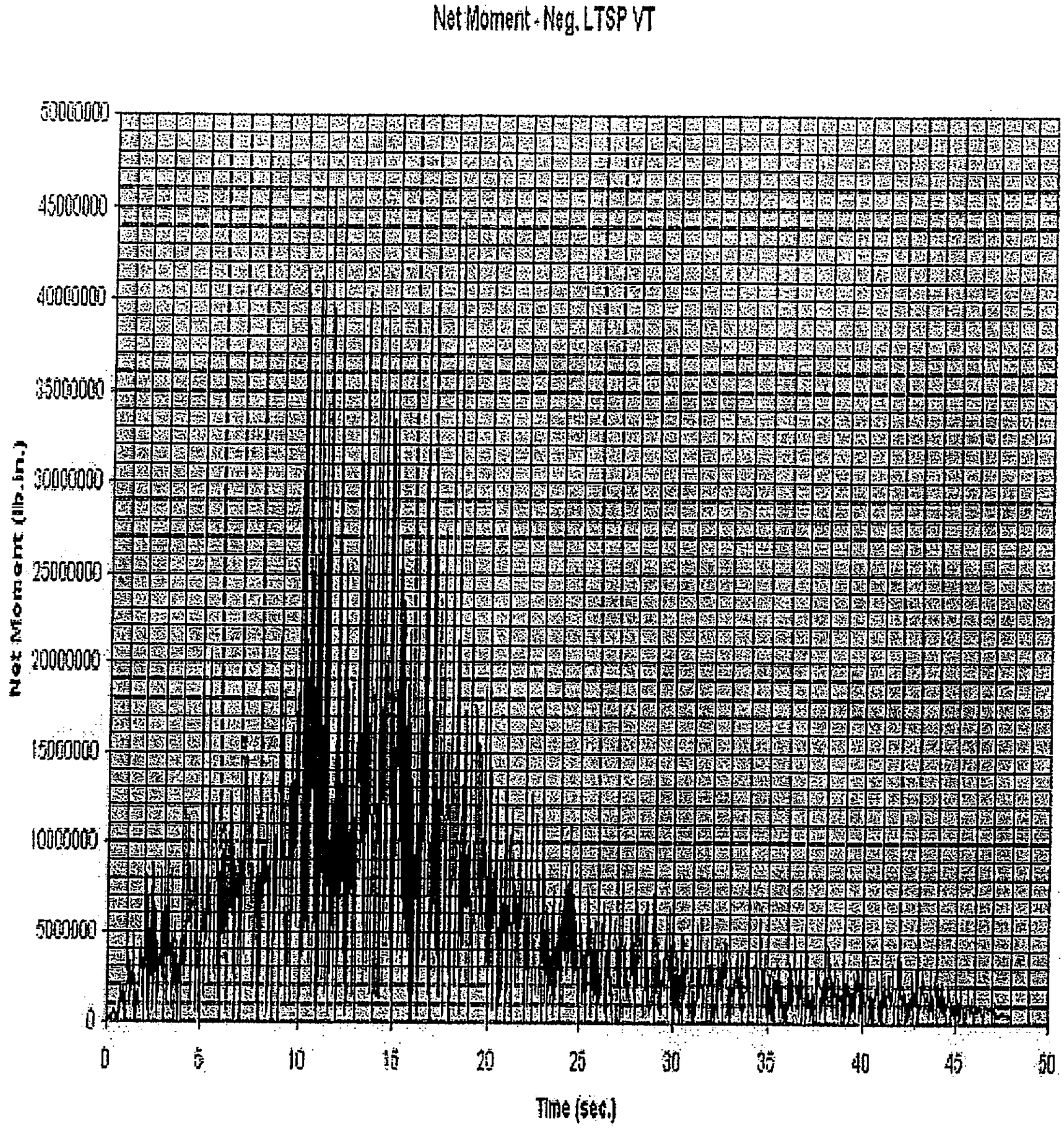


FIGURE 33 – NET MOMENT – LTSP SEISMIC EVENT –NEGATIVE VT EARTHQUAKE

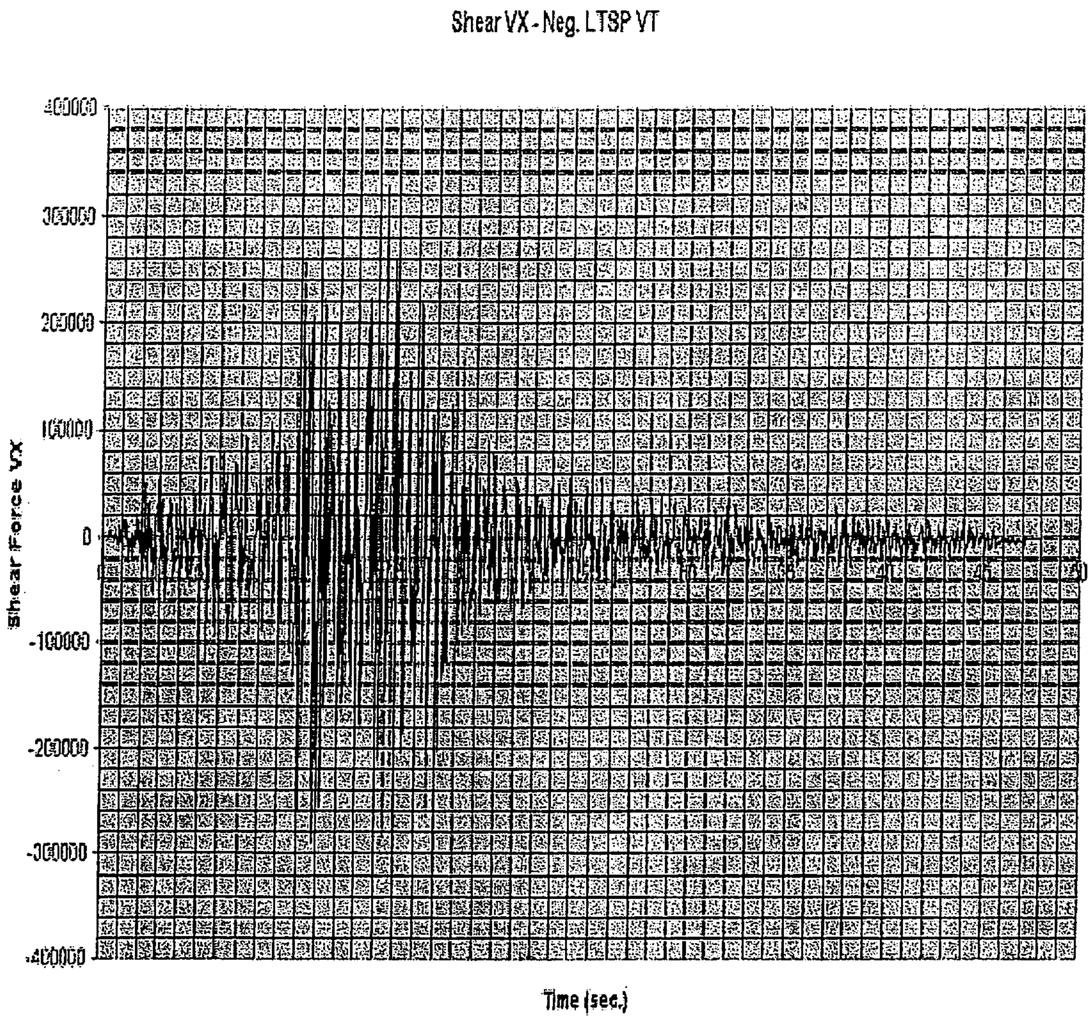


FIGURE 34 – SHEAR VX – LTSP SEISMIC EVENT –NEGATIVE VT EARTHQUAKE

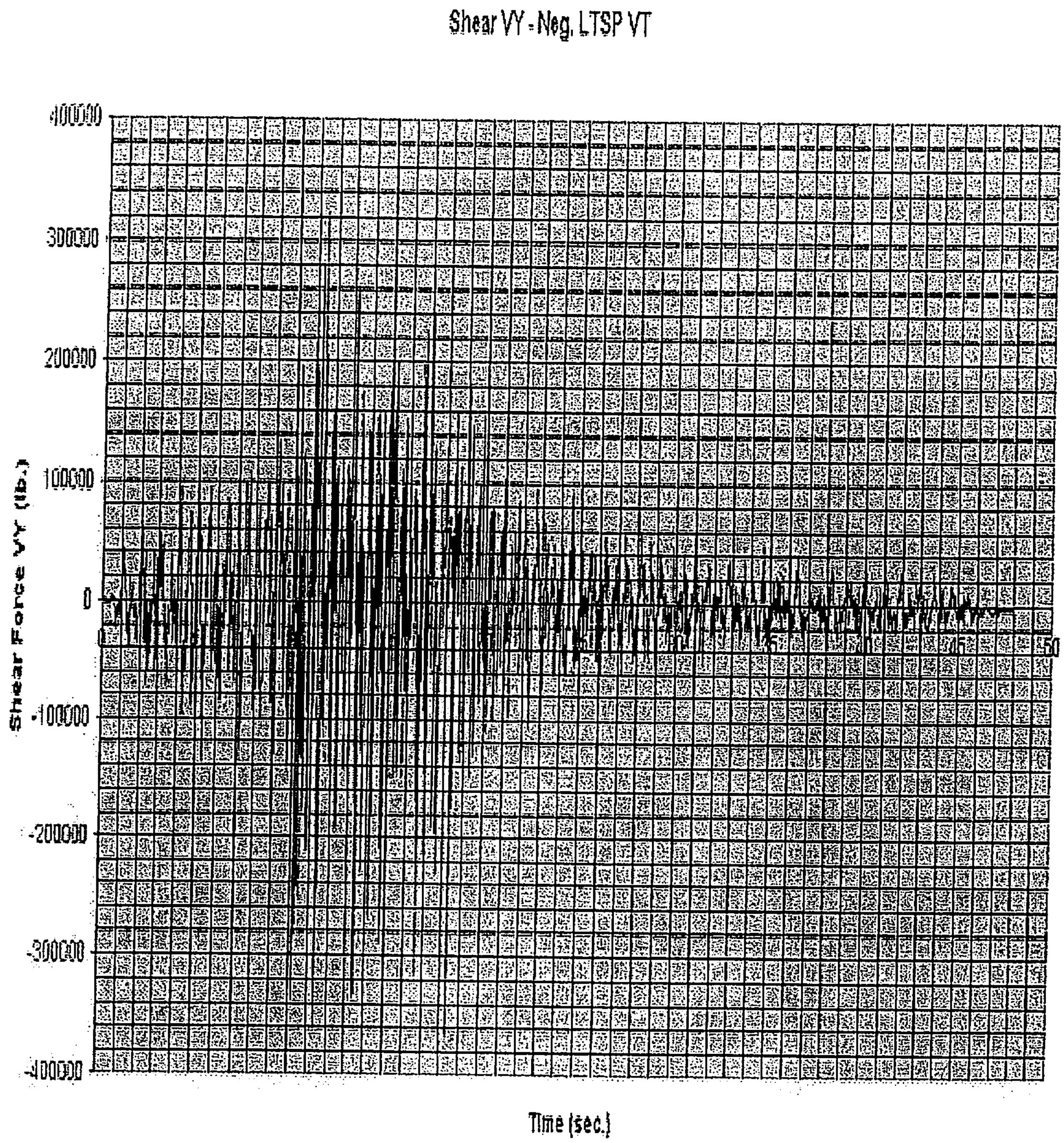


FIGURE 35 – SHEAR VY – LTSP SEISMIC EVENT –NEGATIVE VT EARTHQUAKE

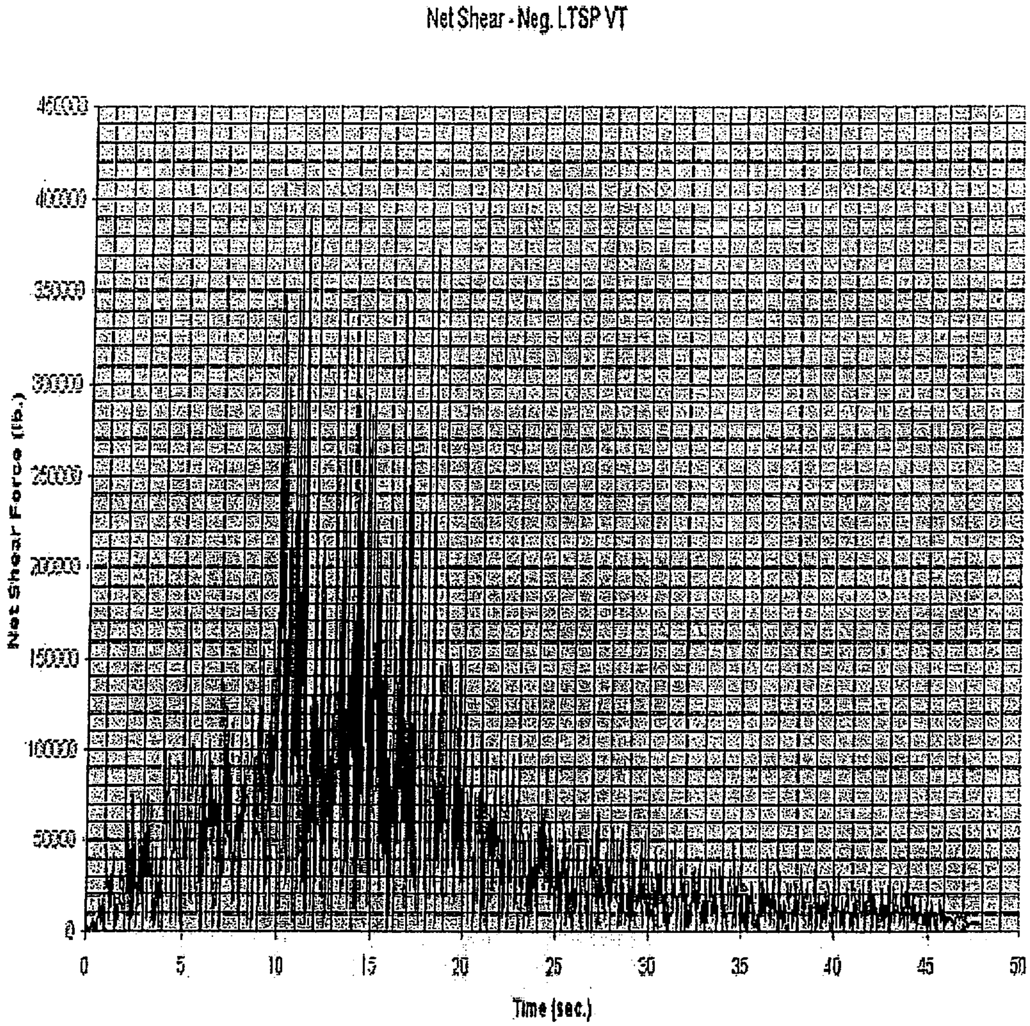


FIGURE 36 – NET SHEAR – LTSP SEISMIC EVENT –NEGATIVE VT EARTHQUAKE

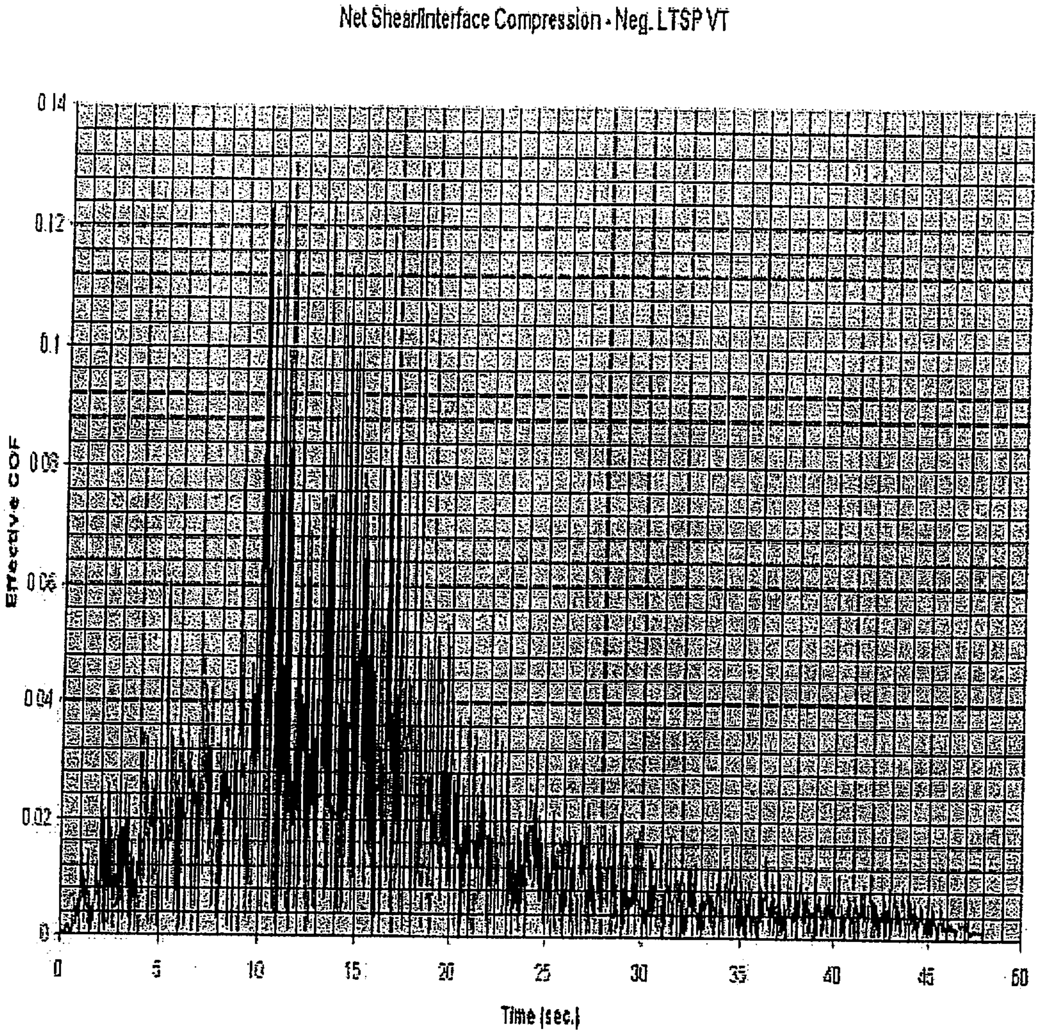


FIGURE 37 – EFFECTIVE COEFFICIENT OF FRICTION – LTSP SEISMIC EVENT –NEGATIVE VT EARTHQUAKE

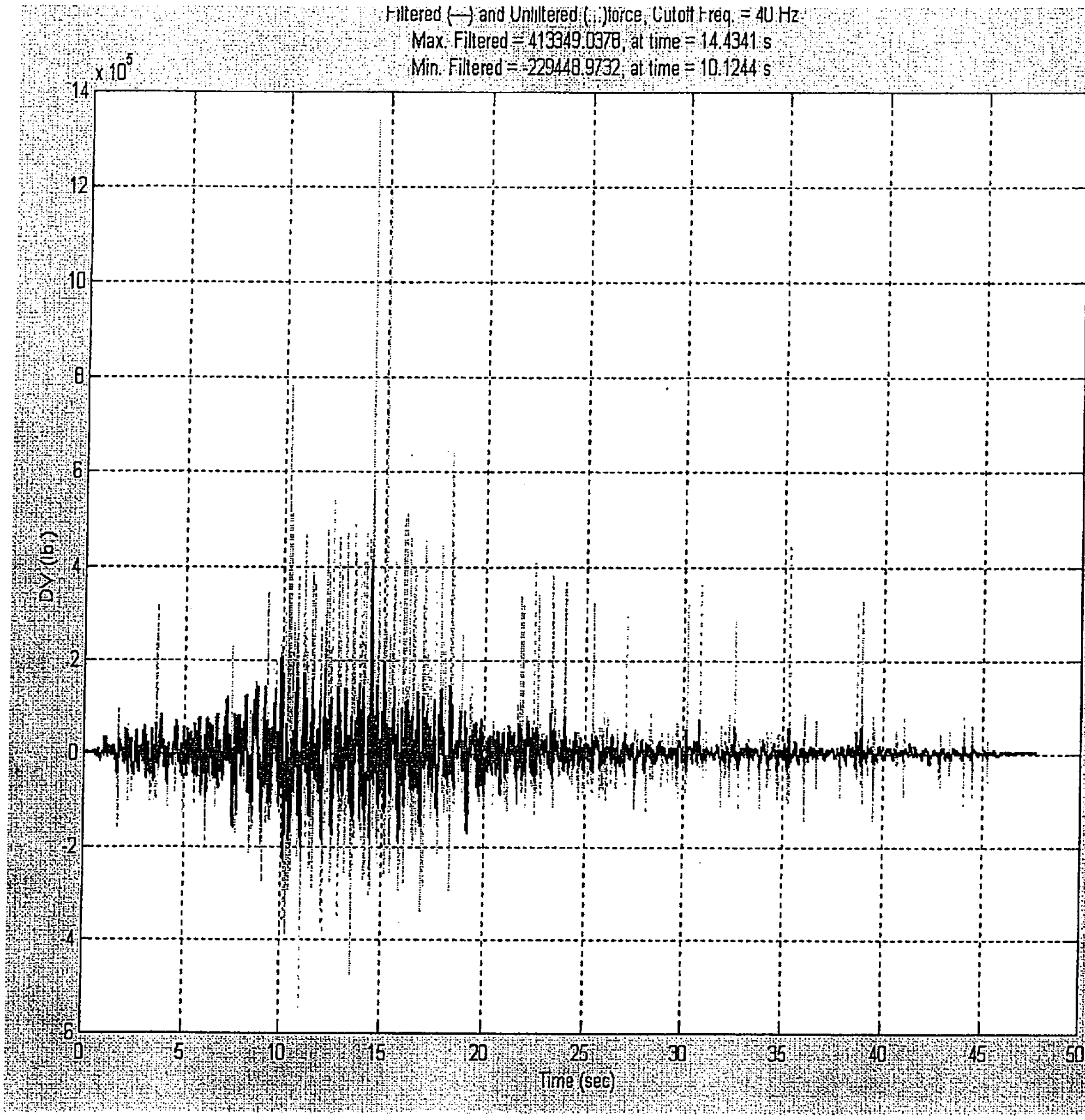


FIGURE 38 COMPRESSION LOAD INCREMENT – HE SEISMIC –NEGATIVE VT EARTHQUAKE

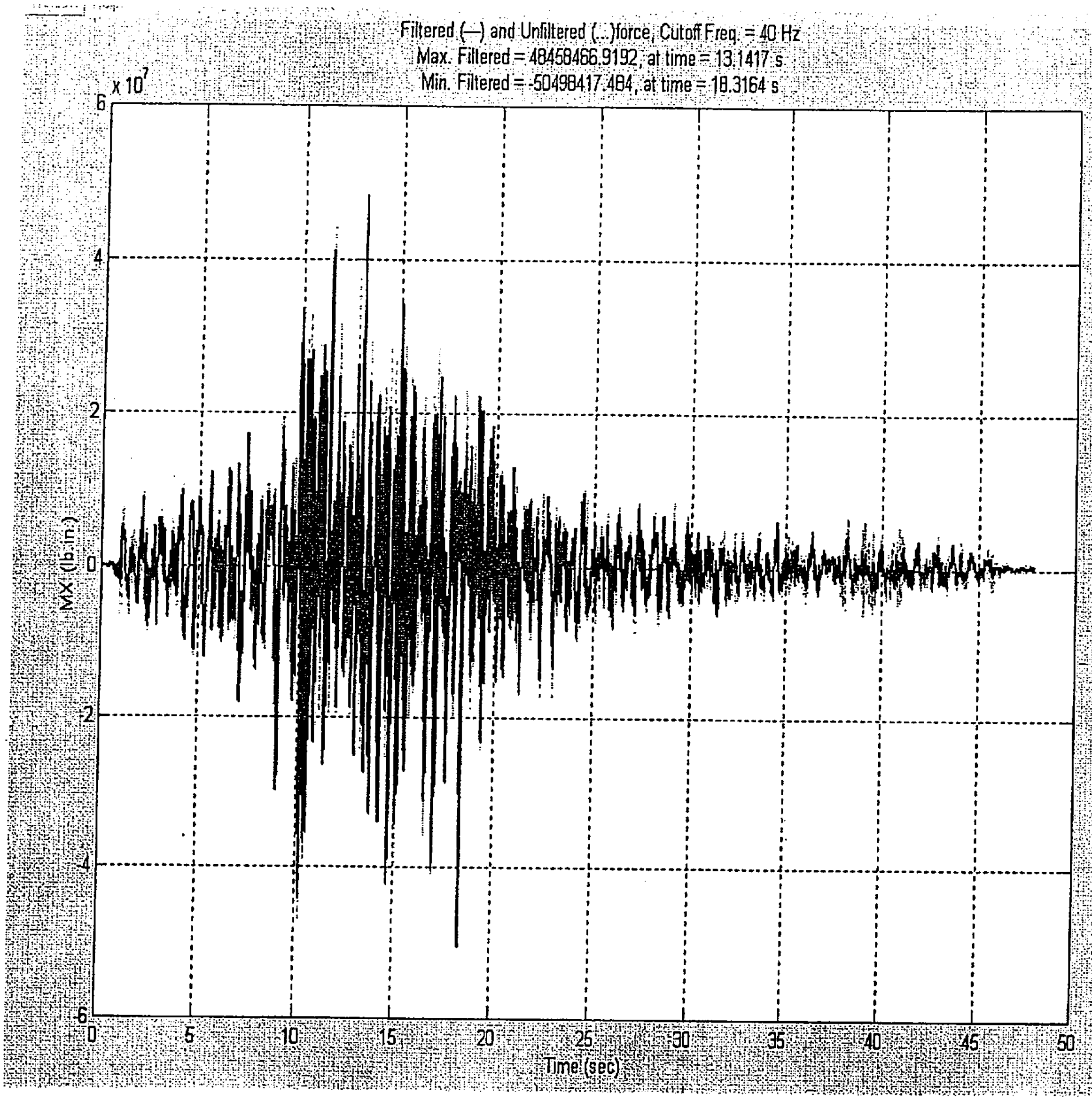


FIGURE 39 – MOMENT MX AT EMBED/CONCRETE INTERFACE – HE SEISMIC EVENT –NEGATIVE VT EARTHQUAKE

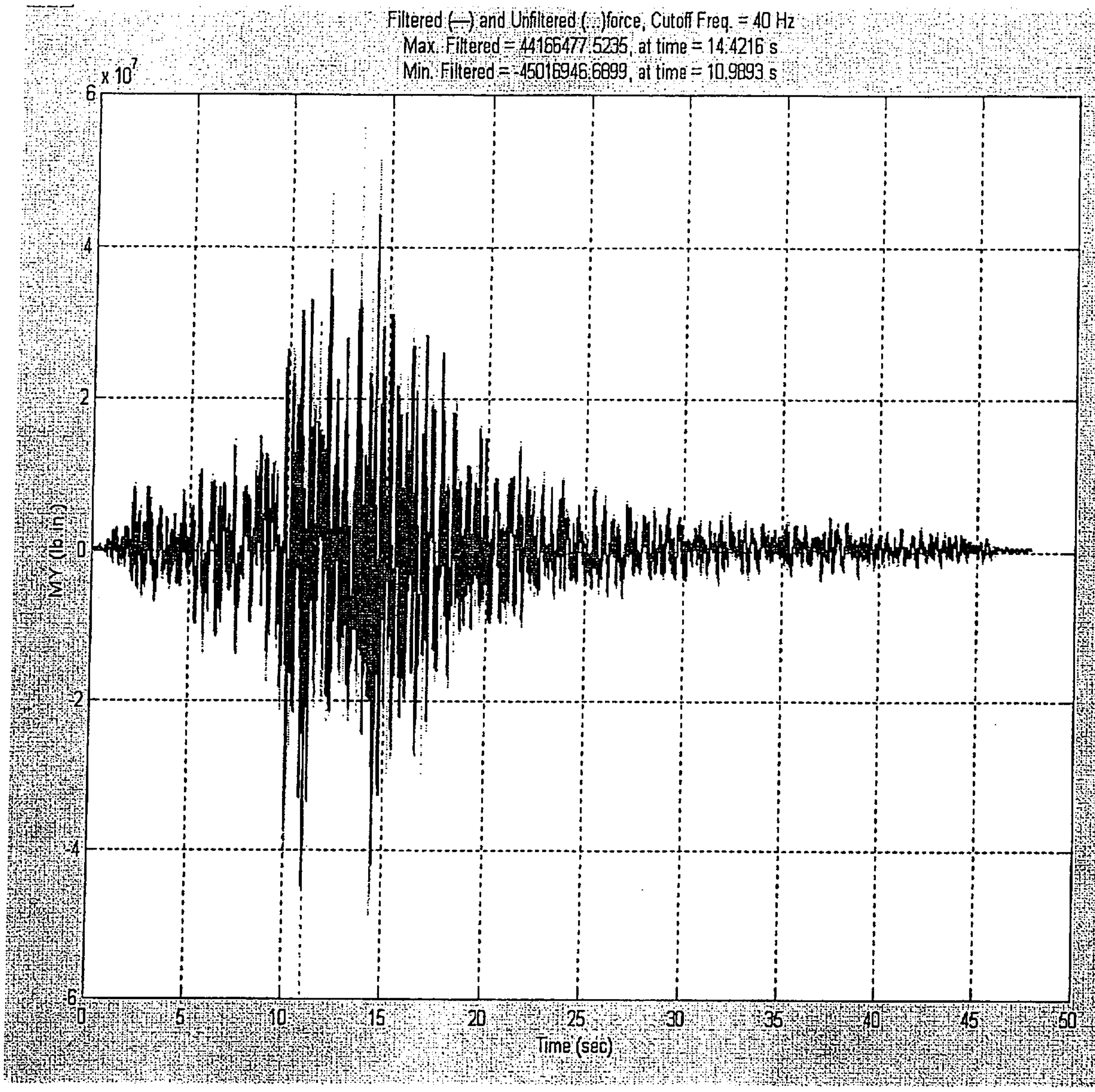


FIGURE 40 – MOMENT MY AT EMBED/CONCRETE INTERFACE – HE SEISMIC EVENT NEGATIVE VT EARTHQUAKE

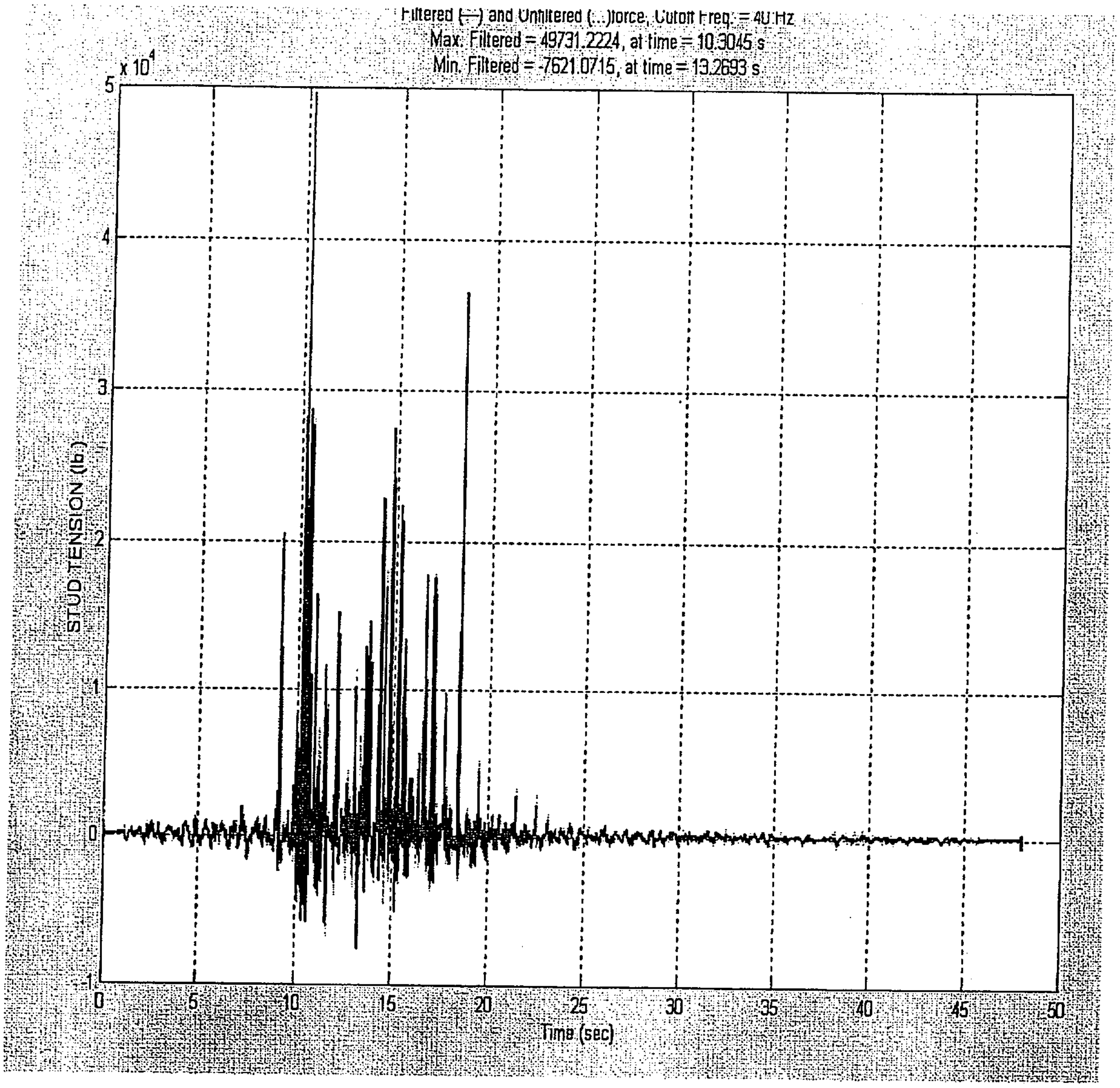


FIGURE 41 – ANCHOR ROD 22 TENSION AT EMBED/CONCRETE INTERFACE – HE SEISMIC EVENT –NEGATIVE VT EARTHQUAKE

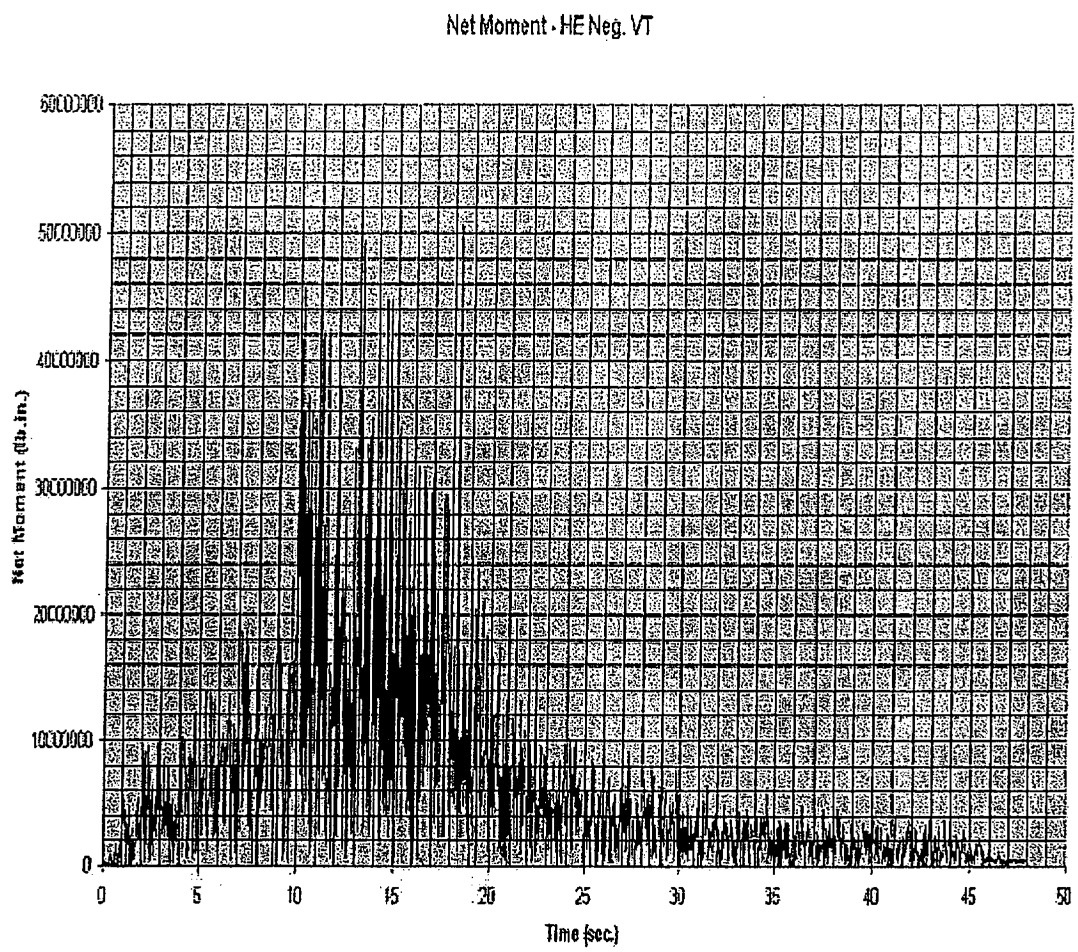


FIGURE 42 – NET MOMENT AT EMBED/CONCRETE INTERFACE – HE SEISMIC EVENT –NEGATIVE VT EARTHQUAKE

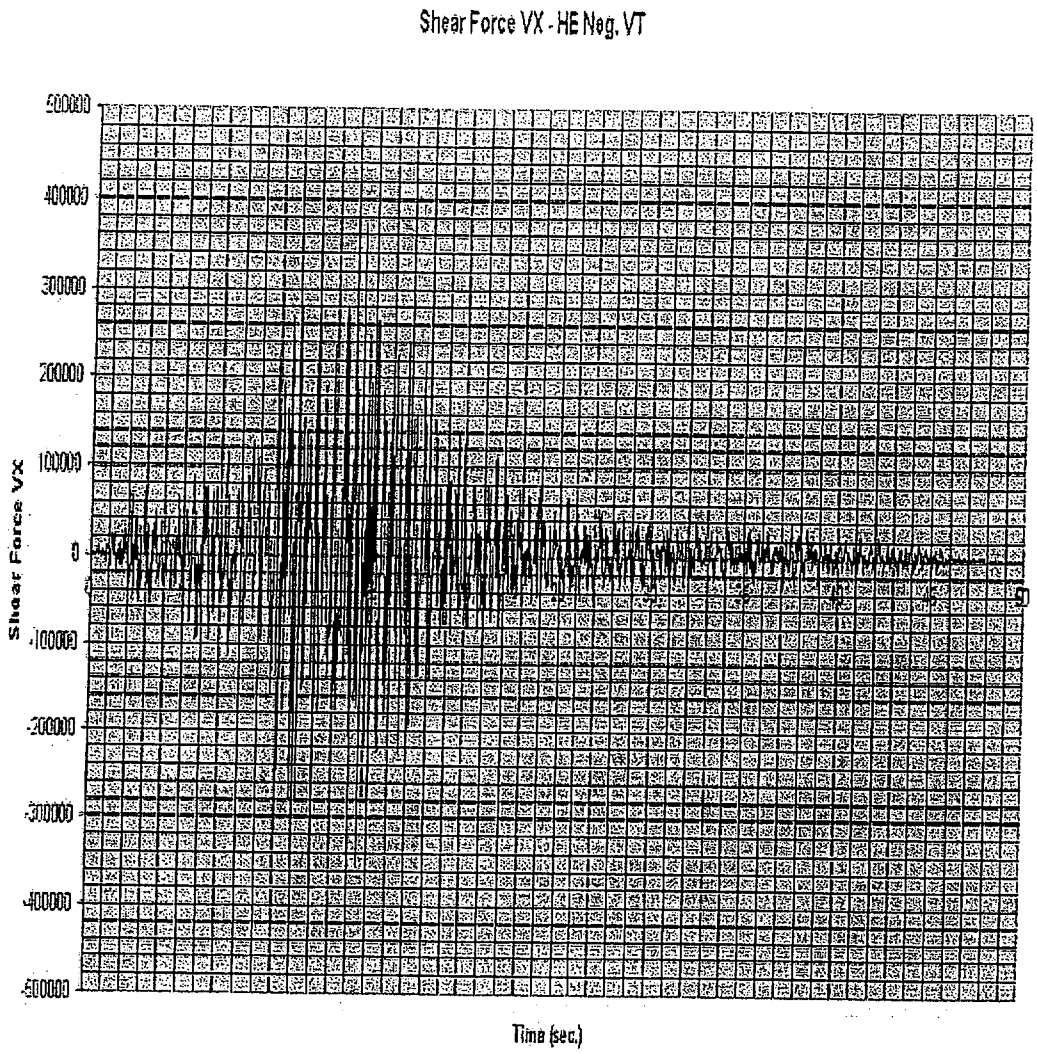


FIGURE 43 – SHEAR VX AT EMBED/CONCRETE INTERFACE – HE SEISMIC EVENT –NEGATIVE VT EARTHQUAKE

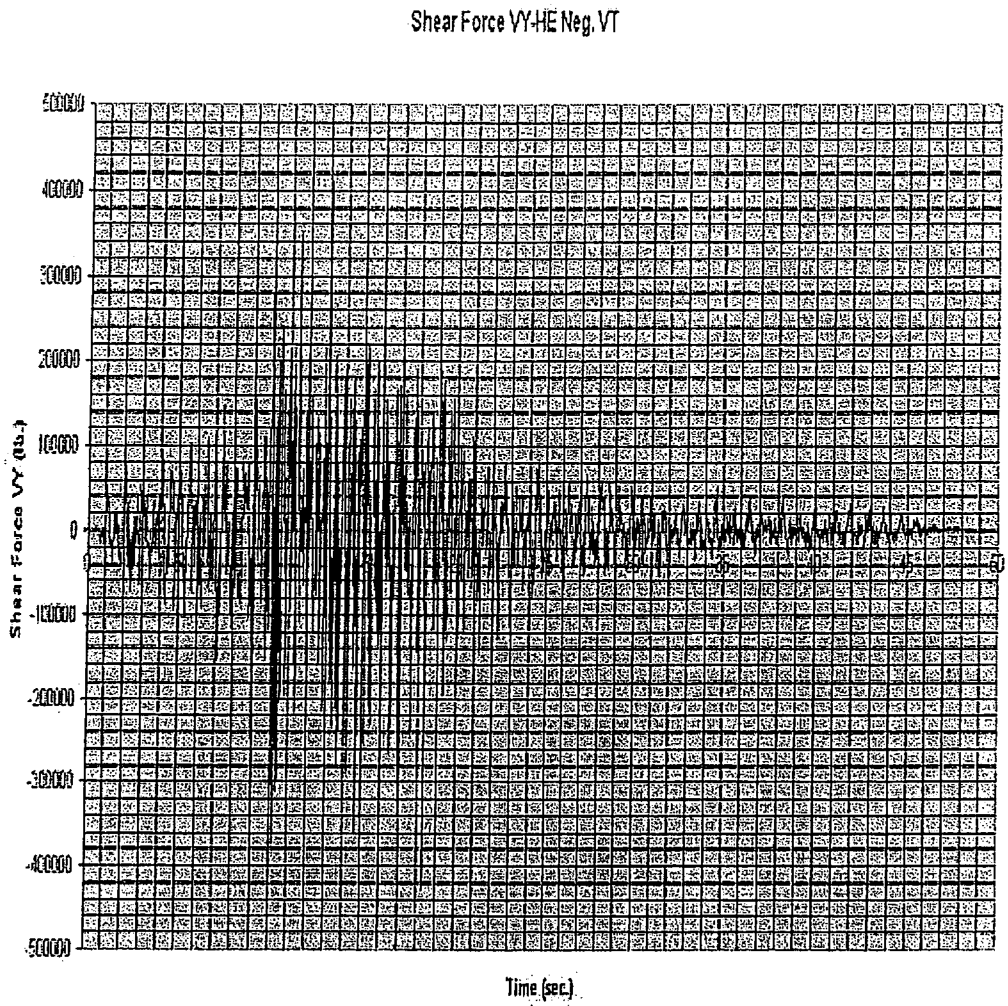


FIGURE 44 – SHEAR VY AT EMBED/CONCRETE INTERFACE – HE SEISMIC EVENT –NEGATIVE VT EARTHQUAKE

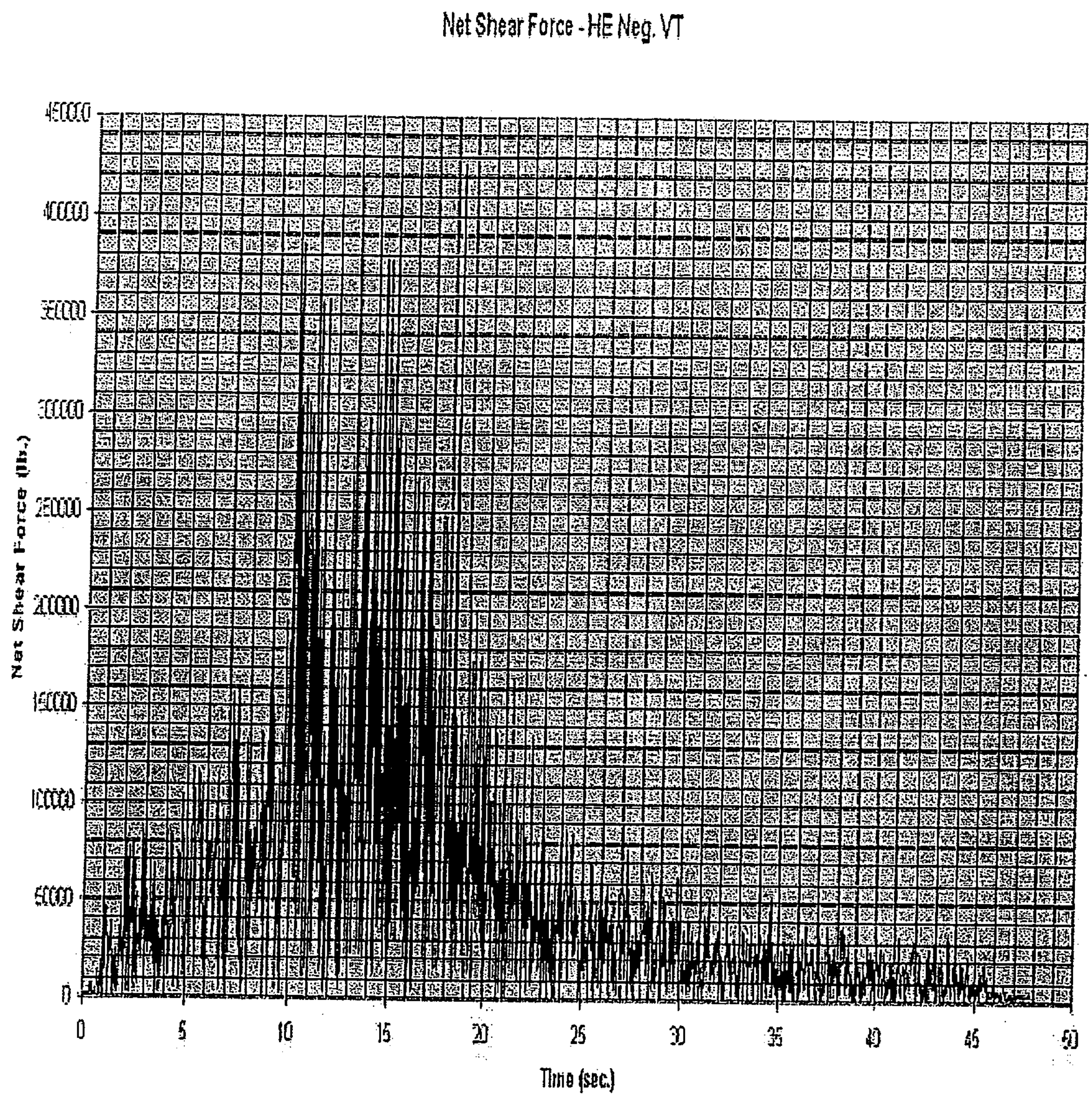


FIGURE 45 – NET SHEAR AT EMBED/CONCRETE INTERFACE – HE SEISMIC EVENT –NEGATIVE VT EARTHQUAKE

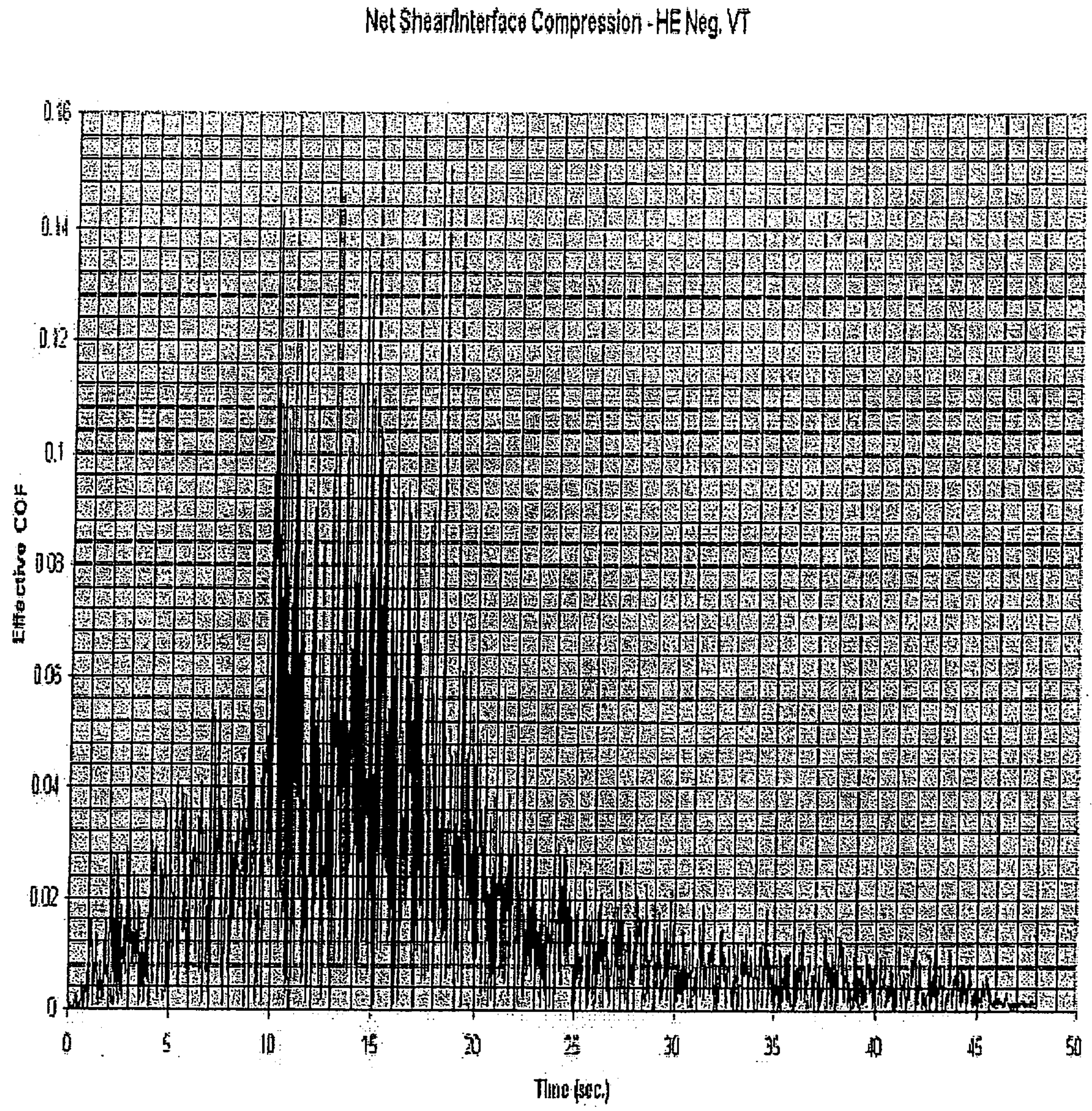


FIGURE 46 – EFFECTIVE COEFFICIENT OF FRICTION – HE SEISMIC EVENT –NEGATIVE VT EARTHQUAKE

13. APPENDICES

Appendix A – Supporting Calculations [Holtec Proprietary]

Appendix B – Sector Lug Finite Element Analysis Input Scripts [Holtec Proprietary]

Appendix C – Post-Processor Fortran and Matlab Scripts [Holtec Proprietary]