PGE

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May 23, 2005

VPN-019-2005

Trojan ISFSI
Docket No. 72-17
License No. SNM-2509

ATTN: Document Control Desk
Director, Spent Fuel Project Office
Office of Nuclear Material Safety and Safeguards
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001

Trojan Independent Spent Fuel Storage Installation (ISFSI)
License Change Application (LCA) 72-05 –
Reduction of the Trojan ISFSI Controlled Area

Pursuant to the requirements of 10 CFR 72.48(c)(2), this letter transmits Portland General Electric Company's (PGE's) request for Nuclear Regulatory Commission (NRC) approval of a reduction of the Trojan ISFSI Controlled Area such that the boundary would be moved from 300 meters from the edge of the Trojan ISFSI Storage Pad to 200 meters from the edge of the Storage Pad. Specifically, this change involves a "departure from a method of evaluation" described in the Trojan ISFSI Safety Analysis Report (SAR), and thus pursuant to 10 CFR 72.48(c)(2)(viii) the change requires NRC approval prior to implementation. It should be noted that although PGE is submitting this request as a request for amendment (LCA 72-05) of the Trojan ISFSI License No. SNM-2509 as required by 10 CFR 72.48(c)(2) and 10 CFR 72.56, no physical change to the Trojan ISFSI license is specifically required or sought as a result of this change. Rather, as detailed in the enclosures to this letter, PGE requests NRC approval of changes to the Trojan ISFSI SAR to reflect the change in analysis methodology and to otherwise implement the change in the Controlled Area boundary.

Enclosure I to this letter provides a description of and reason for the proposed changes and an evaluation of the proposed changes that supports the conclusion that there is no significant impact on public health and safety. Thus, this license amendment request conforms to the standards of 10 CFR 72.46(b)(2) for a determination that the proposed amendment does not present a genuine issue as to whether the health and safety of the public will be significantly affected. Enclosure I to this letter also contains the basis for the determination that this

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LCA 72-05 satisfies the criteria specified in 10 CFR 51.22(c)(11) for a categorical exclusion from the requirements to perform an environmental assessment or to prepare an environmental impact statement. Enclosure II to this letter provides a copy of the affected Trojan ISFSI SAR pages with changes annotated by strikethroughs, insertions, and margin sidebars. Enclosure III to this letter provides a separate "clean" copy of the Trojan ISFSI SAR pages with changes annotated only by margin sidebars.

PGE requests that 60 days be allowed for implementation of the changes proposed herein following NRC approval of this LCA 72-05. Concurrent with implementation of the NRC's approval of this LCA 72-05, PGE will implement conforming changes to Trojan ISFSI programs and procedures, as necessary, in accordance with 10 CFR 72.48.

This application is executed in original form and signed under oath and affirmation as required by 10 CFR 72.16(b) and (c). If you have any questions regarding this correspondence, please contact Mr. Jay P. Fischer, Trojan ISFSI Manager, at (503) 556-7030.

I state under penalty of perjury that the foregoing is true and correct.

Executed on 5/23/2005 by: [signature]
Stephen M. Quennoz
Vice President, Generation

Enclosure I (w/Attachments 1 and 2)
Enclosure II
Enclosure III

c: C. M. Regan, NRC, NMSS, SFPO
Director, DNMS, NRC Region IV
A. Bless, ODOE

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

In the Matter of PORTLAND GENERAL ELECTRIC COMPANY THE CITY OF EUGENE, OREGON, AND PACIFIC POWER & LIGHT COMPANY (TROJAN INDEPENDENT SPENT FUEL STORAGE INSTALLATION)	)))))))	Docket No. 72-17 License No. SNM-2509

CERTIFICATE OF SERVICE

I hereby certify that copies of License Change Application 72-05 associated with License No. SNM-2509 for the Trojan Independent Spent Fuel Storage Installation, dated May 23, 2005, have been served on the following by hand delivery or by deposit in the United States Mail, first class, this 23rd day of May 2005:

State of Oregon
Attn: David Stewart-Smith
Oregon Department of Energy
625 Marion Street NE
Salem, Oregon 97301-3742

Chairman of County Commissioners
Columbia County Courthouse
St. Helens, Oregon 97051

I may be contacted for further information. [signature]

Jay P. Fischer
Manager, Trojan ISFSI
71760 Columbia River Hwy.
Rainier, OR 97048
(503) 556-7030

On this day personally appeared before me Jay P. Fischer, to me known to be the individual who executed the foregoing instrument, and acknowledged that he signed the same as his free act.

GIVEN under my hand and seal this 23rd day of May 2005.

OFFICIAL SEAL
KIMBERLEY A. LEHMAN
NOTARY PUBLIC-OREGON
COMMISSION NO. 346321
MY COMMISSION EXPIRES AUGUST 18, 2005

Kimberley A. Lehman
Notary Public in and for the State of Oregon

Residing at Scappoose, OR
My commission expires 8-18-05

Trojan Independent Spent Fuel Storage Installation (ISFSI) License Change Application (LCA) 72-05 – Reduction of the Trojan ISFSI Controlled Area

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1. Description Of and Reason for Proposed Changes

Introduction

This license amendment request proposes a reduction in the Trojan ISFSI Controlled Area size such that the boundary would be moved from 300 meters from the edge of the Trojan ISFSI Storage Pad to 200 meters from the edge of the Storage Pad. As detailed further below, this change to the Controlled Area requires associated changes to the Trojan ISFSI Safety Analysis Report (SAR), including a change to the analysis method described in the Trojan ISFSI SAR for calculating ISFSI direct radiation doses that were used, in part, to establish the current Controlled Area boundary.

Portland General Electric Company (PGE) is seeking this reduction of the Trojan ISFSI Controlled Area primarily to facilitate the efficient long-term management and security of the spent nuclear fuel and fuel-related materials stored in the Trojan ISFSI while allowing PGE flexibility for future use of the site. Specifically, this change eliminates Trojan ISFSI program and procedural requirements for access controls on site areas for which such controls are neither necessary nor warranted to ensure the protection of the health and safety of the public and the environment.

Background

The current Trojan ISFSI Controlled Area boundary immediately surrounds the Trojan ISFSI and extends out to a distance of 300 meters from the edge of the Storage Pad.[1] The Trojan ISFSI Controlled Area boundary was established at 300 meters based on the results of the Trojan ISFSI shielding and confinement analyses and the requirements of 10 CFR 72.104 and 10 CFR 72.106. The Trojan ISFSI shielding analysis of predicted direct radiation dose from the Trojan ISFSI is detailed in proprietary Holtec Report No. HI-2012749 and summarized in Trojan ISFSI SAR Section 7.3.2. The Trojan ISFSI confinement analysis of postulated normal, off-normal, and/or hypothetical accident effluent releases is detailed in proprietary Holtec Report No. HI-2012677 and summarized in Trojan ISFSI SAR Sections 7.2.2, 8.1.3, 8.1.4, and 8.2.1.[2]

The Trojan ISFSI shielding analysis was performed prior to loading the ISFSI storage casks to conservatively predict dose rates at various distances from a single cask and from the entire

[1] Trojan ISFSI SAR, Section 2.1.2 and Figure 2.1-2.
[2] Holtec Report No. 2012749, "Shielding Evaluation for the Trojan ISFSI Completion Project," and Holtec Report No. 2012677, "Trojan ISFSI Site Boundary Confinement Analysis," were submitted to the Nuclear Regulatory Commission (NRC) as proprietary documents by PGE Letter No. VPN-033-2002 (Enclosure I, Attachment 2) dated July 25, 2002.

ISFSI. These results were then used to establish (in conjunction with predicted effluent release results as required by 10 CFR 72.104) the Trojan ISFSI Controlled Area boundary at 300 meters from the edge of the Storage Pad, and to conservatively estimate occupational doses and annual dose to an individual member of the public at both the Controlled Area boundary and at the nearest resident distance of 660 meters. For establishment of the Controlled Area boundary at 300 meters, the Trojan ISFSI shielding analysis incorporated the extremely conservative assumption that each cask is uniformly loaded with design basis fuel assemblies, i.e., assemblies having an assumed uniform burnup and cooling time that conservatively bounds the actual burnup and cooling times for all spent fuel stored in the ISFSI. The shielding analysis used computer modeling (SAS2H and ORIGEN-S modules of SCALE 4.4) to develop radiation source terms based on this assumption. Radiation transport simulation (MCNP 4A) was then used to calculate dose rates at various distances from a single cask and from an array of casks.

As detailed in Trojan ISFSI SAR Sections 7.3.2.1 and 7.3.2.2, the shielding analysis incorporated considerable conservatism, such that actual direct radiation dose rates following ISFSI loading were anticipated to be well below the predicted values. Following the completion of Trojan ISFSI loading, measurements of actual radiation dose emanating from the ISFSI confirmed this extreme conservatism in the calculated values, with actual dose rates measured to be approximately five (5) percent or less of predicted dose rates at approximately equivalent distances/locations. In light of this confirmation it was recognized that the Trojan ISFSI Controlled Area was unnecessarily large, and thus new Trojan ISFSI (TI) Calculation No. TI-159, "Calculation to Establish Trojan ISFSI Controlled Area Boundary at 200 Meters," was performed based on the actual direct radiation measurements with the purpose of reducing the size of the Controlled Area. A copy of Calculation No. TI-159 is provided as Attachment 1 to this enclosure.

Description of Changes

The changes proposed in this license amendment request involve actions necessary to establish the Trojan ISFSI Controlled Area boundary at a distance of 200 meters from the edge of the Storage Pad. As stated above, the Trojan ISFSI Controlled Area boundary was established and is currently maintained at a distance of 300 meters from the edge of the Storage Pad based on the results of the Trojan ISFSI shielding and confinement analyses and the requirements of 10 CFR 72.104 and 10 CFR 72.106. In support of moving the Controlled Area boundary to 200 meters as proposed herein, PGE has reviewed the Trojan ISFSI shielding and confinement analyses to identify any necessary changes. It is concluded that changes are required to the Trojan ISFSI shielding analysis, as detailed further in this license amendment request. However, as detailed further in Section 2 of this license amendment request, changing the Trojan ISFSI Controlled Area boundary from 300 meters to 200 meters does not involve a change to the Trojan ISFSI confinement analysis, since the confinement analysis of postulated normal, off-normal, and hypothetical accident radiological effluent releases from the Trojan ISFSI already assumes a distance of 200 meters or less from the release point to the location where the calculated dose would be received. Thus, design basis radioactive effluent dose results calculated for the Trojan ISFSI Controlled Area boundary are unaffected by the proposed Controlled Area boundary change.

The basis for the proposed changes to the Trojan ISFSI Controlled Area boundary, including the proposed changes to the current shielding analysis, are documented in the attached Calculation No. TI-159. As described further below, it is noted that using actual dose rate measurements to determine the Controlled Area boundary location, rather than using the current shielding analysis methodology involving computer modeling and simulation based on design basis fuel assemblies as described above, represents a change to one or more elements of the shielding analysis methodology in a non-conservative direction. Thus, in accordance with 10 CFR 72.48(c)(2)(viii), this change requires prior NRC approval via license amendment.

Shielding Analysis Changes

The methodology incorporated in the attached Calculation No. TI-159 involves the use of actual measurements of direct radiation emanating from the Trojan ISFSI to conservatively establish the Trojan ISFSI Controlled Area boundary at a distance of 200 meters from the edge of the Storage Pad. Due to intervening obstructions (i.e., site structures, hills, earthen berms, and trees), it is not possible beyond a distance of approximately 65 meters to obtain a clear line of sight to the Trojan ISFSI to allow representative direct measurements of radiation dose rate emanating from the ISFSI. Thus, the methodology documented in Calculation No. TI-159 involves the application of a scaling factor to the results of the Trojan ISFSI shielding analysis to conservatively reflect actual measured radiation dose rates rather than dose rates calculated based on extremely conservative design basis fuel assumptions and related computer modeling and simulations as described in Trojan ISFSI SAR Sections 7.2.1, 7.3.2.1, and 7.3.2.2.

As detailed in the attached Calculation No. TI-159, the scaling factor is derived by taking direct measurements of the radiation dose rate from the Trojan ISFSI at distances/locations allowing representative measurements, adjusting each measured value to conservatively account for instrument accuracy and background radiation levels, and dividing each result by the dose rate value predicted at the approximately equivalent distance and location by the Trojan ISFSI shielding analysis. The resultant scaling factor (i.e., ratio of corrected measured value to predicted design value) is then applied to the design basis dose rate predicted by the current shielding analysis[3] for a distance of 200 meters. The result is a dose rate calculated based on actual dose rate measurements for a distance of 200 meters from the Trojan ISFSI. Multiplying this value by the same occupancy time (2080 hours/year) as is used in the current shielding analysis[4] results in a calculated annual dose at 200 meters (due to direct radiation) based on actual dose rate measurements. As presented in the attached Calculation No. TI-159, this calculated annual dose at a distance of 200 meters from the Trojan ISFSI is 3.5 mrem/year, which

[3] The design basis "dose-versus-distance" values calculated in the Trojan ISFSI shielding analysis are summarized in Trojan ISFSI SAR Table 7.3-9.
[4] As detailed further in Trojan ISFSI SAR Section 7.6.2, the 2080-hours/year occupancy factor was used in the current shielding analysis in accordance with Interim Staff Guidance (ISG) Document 13 to represent a conservative maximum estimate of a real individual's occupancy time at the Controlled Area boundary.

is significantly less than the current shielding analysis design annual dose value of 18.4 mrem/year calculated for the 300-meter Trojan ISFSI Controlled Area boundary.

As documented in the attached Calculation No. TI-159 and in the evaluation presented in Section 2 of this license amendment request, the new annual dose result, calculated for a distance of 200 meters based on actual dose rate measurements, ensures that total doses (including effluent dose contribution) at 200 meters from the Trojan ISFSI remain well below regulatory limits for Controlled Area boundary doses. This result confirms the acceptability of changing the Trojan ISFSI Controlled Area boundary from 300 meters to 200 meters from the edge of the Storage Pad. Thus, PGE requests that the NRC approve the establishment of the Trojan ISFSI Controlled Area boundary at 200 meters from the edge of the Storage Pad as proposed herein.

The changes to the shielding analysis results supporting the establishment of the Controlled Area boundary at 200 meters as described above are reflected in the proposed Trojan ISFSI SAR revision provided concurrently with this license amendment request (Enclosures II and III to VPN-019-2005). Upon NRC approval of the Controlled Area boundary change requested herein, the dose rate value calculated in the attached Calculation No. TI-159 based on actual dose rate measurements will become the bounding design basis dose rate for the Trojan ISFSI 200-meter Controlled Area boundary, replacing the dose-versus-distance value calculated for a distance of 200 meters in the current shielding analysis. Notwithstanding, the current design basis shielding analysis described in Trojan ISFSI SAR Sections 7.3.2.1, 7.3.2.2, 7.4, and 7.6 remains as the bounding analysis for predicted occupational dose rates and for annual dose to the nearest resident (660 meters).

Safety Analysis Report Changes

It should be noted that although PGE is submitting this request as a request for amendment (LCA 72-05) of the Trojan ISFSI License No. SNM-2509 as required by 10 CFR 72.48(c)(2) and 10 CFR 72.56, no physical change to the Trojan ISFSI license is specifically required or sought as a result of this change. Rather, PGE requests NRC approval of changes to the Trojan ISFSI SAR to reflect the change in shielding analysis methodology as described above, and to otherwise implement the change in the Controlled Area boundary from 300 meters to 200 meters from the edge of the Storage Pad.

The changes proposed herein are indicated in annotated markups of the affected Trojan ISFSI SAR pages provided concurrently with this license amendment request as enclosures to PGE letter VPN-019-2005. Specifically, Enclosure II to VPN-019-2005 provides a copy of the affected Trojan ISFSI SAR pages with changes annotated by strikethroughs, insertions, and margin sidebars. Enclosure III to VPN-019-2005 provides a separate "clean" copy of the Trojan ISFSI SAR pages with changes annotated only by margin sidebars. To assist the NRC in its review of the Trojan ISFSI SAR changes, a detailed list providing a description of and reason for each proposed change to the Trojan ISFSI SAR is provided in Attachment 2 to this enclosure.

2. Evaluation of Proposed Changes Supporting Determination of No Safety Impact

Introduction

The proposed changes described in Section 1 above will have no significant impact on public health and safety. As discussed further below, the total radiation doses to an individual on or beyond the proposed Trojan ISFSI Controlled Area boundary at 200 meters during normal and off-normal conditions are projected to be significantly less than the total doses calculated in the current shielding and confinement analyses for the Controlled Area boundary at 300 meters. Thus, these calculated doses are shown to remain well below the dose limits specified in 10 CFR 72.104.

Furthermore, as detailed further below, the total doses to an individual on or beyond the proposed 200-meter Controlled Area boundary due to postulated accidents are not significantly impacted by the changes proposed herein, and thus remain well below the limits specified in 10 CFR 72.106. Specifically, this evaluation confirms that the changes proposed herein do not involve a significant increase in the probability or consequences of an event, equipment malfunction, or accident previously evaluated, nor do they create the possibility of a new or different kind of event, equipment malfunction, or accident from any previously evaluated. Therefore, this license amendment request conforms to the standards of 10 CFR 72.46(b)(2) for a determination that the proposed amendment does not present a genuine issue as to whether the health and safety of the public will be significantly affected.

Evaluation

A. Total Normal and Off-Normal Doses at Controlled Area Boundary

As discussed in Section 1 above, the shielding analysis performed for the current 300-meter Controlled Area boundary incorporated considerable conservatism, such that actual direct radiation dose rates following ISFSI loading were anticipated to be well below the predicted values. Much of this conservatism in the Trojan ISFSI shielding analysis was incorporated in the assumption that each cask is uniformly loaded with design basis fuel assemblies. This assumption was considered at the time to be extremely conservative, and the recent measurements of actual radiation dose emanating from the Trojan ISFSI as documented in the attached Calculation No. TI-159 confirm this fact. Specifically, as discussed in Section 1 above, measured dose rates were found to be approximately five (5) percent or less of predicted dose rates at approximately equivalent distances/locations.

A high level of conservatism in the original Trojan ISFSI shielding analysis was appropriate and necessary since the analysis was performed prior to loading the ISFSI storage casks, and predicting with exact precision what radiation dose rates would actually be at various distances from the fully loaded ISFSI was not practicable. However, now that the Trojan ISFSI is loaded and actual dose rates emanating from the ISFSI have been measured, the extreme conservatism used in the original shielding analysis to establish the Controlled Area boundary at a distance of 300 meters is no longer necessary or appropriate. Eliminating this conservatism by the use of actual measurements to conservatively recalculate the direct dose rate at 200 meters from the Trojan ISFSI, and to use this new calculated value to establish the Controlled Area boundary at 200 meters, therefore is appropriate and does not adversely impact public health and safety.

This conclusion is supported by the results of the attached Calculation No. TI-159, which confirm that the calculated total annual doses at or beyond the proposed 200-meter Controlled Area boundary as a result of ISFSI direct radiation and postulated normal and off-normal effluent releases are well below the regulatory dose limits specified in 10 CFR 72.104. Derived from the results of the attached Calculation No. TI-159, Table 1 below allows for ready comparison of the normal and off-normal condition total annual doses calculated for the 200-meter Controlled Area boundary to the total annual dose calculated in the original shielding analysis for the current 300-meter boundary, and to the applicable 10 CFR 72.104 annual dose limit. The dose results in this table for the 200-meter Controlled Area boundary are incorporated into the proposed revision to Trojan ISFSI SAR Table 7.4-4 that is provided concurrently with this license amendment request.

Table 1

	Total Dose Rate (mrem/year) (300 meters)[a]	**Total Dose Rate (mrem/year) (200 meters)[b]**	**10 CFR 72.104 Limits (mrem/year)**
10CFR72.104(a) – Normal + Off-Normal			
Whole Body ADE	18.533	3.6	25
Thyroid ADE	18.4	3.5	75
Critical Organ ADE (Max)	19.98	5.1	25

ADE: Annual Dose Equivalent
[a] Direct dose contribution is approximately 18.4 mrem/yr; see current Trojan ISFSI SAR Table 7.4-4
[b] Direct dose contribution is approximately 3.5 mrem/yr; see revised Trojan ISFSI SAR Table 7.4-4

As detailed further below within the portion of this evaluation related to "effluent releases," the contribution to the total doses specified in Table 1 above due to postulated normal and off-normal condition radioactive effluent releases is not affected by the Controlled Area boundary change proposed herein. The reason that calculated effluent dose consequences are unaffected by these changes is because the current Trojan ISFSI SAR confinement analysis conservatively calculates normal and off-normal dose consequences assuming a 200-meter (or less, as detailed further below) distance from the release point. It is noted that changing the Controlled Area boundary from 300 meters to 200 meters effectively eliminates the conservatism currently employed in the Trojan ISFSI SAR (Sections 7.2.2 and 8.1.4; Table 7.4-4) confinement analysis of using a 200-meter (or less, as detailed further below) atmospheric dispersion factor to calculate postulated normal and off-normal effluent dose consequences at a distance of 300 meters. However, with calculated total doses at the 200-meter Controlled Area boundary well below regulatory limits as shown in Table 1 above, this conservatism clearly is not necessary to ensure public health and safety.

Based on the above, the proposed change in the Trojan ISFSI Controlled Area boundary from 300 meters to 200 meters from the edge of the Storage Pad involves a significant reduction in the calculated total radiation doses to an individual on or beyond the Trojan ISFSI Controlled Area boundary during normal and off-normal conditions. Furthermore, these calculated doses are shown to remain well below the dose limits specified in 10 CFR 72.104.

It is noted that given land usage patterns and topographical features in the vicinity of the Trojan ISFSI, changing the Trojan ISFSI Controlled Area boundary as described herein is not anticipated to have any measurable effect on occupancy and resultant minimal dose received by members of the public in the area that is between the current 300-meter Controlled Area boundary and the proposed 200-meter Controlled Area boundary. Additionally, natural and man-made topographical features, including site structures, hills, earthen berms, and trees, greatly reduce the actual direct radiation dose as measured at the Controlled Area boundary.[5] With consideration for this fact and that as described in the Trojan ISFSI SAR, effluent releases are not expected as a result of normal operation of the Trojan ISFSI, actual radiation doses experienced at the 200-meter Controlled Area boundary are anticipated to be even less than the calculated total radiation doses as presented in Table 1 above. Based on the above, the Trojan ISFSI Controlled Area boundary change proposed herein will not result in any significant increase in radiation exposure to the public.

B. Determination of No Significant Increase in Probability or Consequences

The change in the Trojan ISFSI Controlled Area boundary from 300 meters to 200 meters as proposed herein does not involve an increase in the probability or consequences of an event, equipment malfunction, or accident previously evaluated in the Trojan ISFSI SAR. The events and accidents analyzed in the Trojan ISFSI SAR may be categorized into five general areas: (1) effluent releases; (2) thermal; (3) structural (e.g., MPC drops, impacts, pressurization, cask tipover); (4) natural phenomena (e.g., earthquake, volcano, lightning, tornado); and (5) fires/explosions. The location of the Trojan ISFSI Controlled Area boundary does not play any significant role in initiating/causing any of these analyzed events or accidents, and thus the proposed change in the Controlled Area boundary would not in any significant way impact the probability of occurrence of any event or accident previously analyzed. Therefore, the remainder of this portion of the evaluation is focused on the potential impacts of the proposed Trojan ISFSI Controlled Area boundary change on the consequences of these categories of events/accidents previously evaluated in the Trojan ISFSI SAR.

[5] As described in Section 1 above, it was for this reason that a scaling factor was used to calculate direct radiation dose rate at a distance of 200 meters, in lieu of using actual dose rate measurements at 200 meters.

(1) Effluent Releases

Events/accidents categorized above as "effluent releases" include those events/accidents described in Trojan ISFSI SAR Sections 7.2.2, 8.1.3, 8.1.4, and 8.2.1. Changing the Trojan ISFSI Controlled Area boundary from 300 meters to 200 meters does not require any change to the calculated dose consequences of these events/accidents as previously analyzed. Specifically, the analyses of postulated normal, off-normal, and hypothetical accident effluent releases from within the Trojan ISFSI cask confinement boundary presented in Trojan ISFSI SAR Sections 7.2.2, 8.1.4, and 8.2.1 assume a distance of 200 meters from the release point to where the calculated dose would be received (i.e., uses an atmospheric dispersion factor [χ/Q] for 200 meters). The analysis presented in Trojan ISFSI SAR Section 8.1.3 of an event involving an off-normal effluent release of radioactive contamination that may reside on surfaces exterior to the cask confinement boundary assumes a distance of 100 meters (i.e., uses an atmospheric dispersion factor for 100 meters). Therefore, moving the Trojan ISFSI Controlled Area boundary from 300 meters to 200 meters from the edge of the Storage Pad does not require a change to the Trojan ISFSI SAR analyses or the underlying confinement analysis.

As noted previously, changing the Controlled Area boundary from 300 meters to 200 meters effectively eliminates the conservatism currently employed in the Trojan ISFSI SAR analysis of using a 200-meter atmospheric dispersion factor to calculate postulated normal, off-normal, and hypothetical accident effluent dose consequences at a distance of 300 meters. Similarly, changing the Controlled Area boundary from 300 meters to 200 meters effectively reduces the conservatism currently employed in the Trojan ISFSI SAR analysis of using a 100-meter atmospheric dispersion factor to calculate the effluent dose consequences of the off-normal effluent release of external radioactive contamination at a distance of 300 meters. However, with calculated total doses at the 200-meter Controlled Area boundary confirmed to remain well below the applicable regulatory limits specified in 10 CFR 72.104 and 10 CFR 72.106 for postulated normal, off-normal, and hypothetical accident conditions, this conservatism clearly is not necessary to ensure public health and safety.

Based on the above, it is confirmed that for postulated normal, off-normal, and hypothetical accident conditions analyzed in the Trojan ISFSI SAR involving a radiological effluent release from the Trojan ISFSI, the proposed Trojan ISFSI Controlled Area boundary change does not involve any significant increase in the consequences of an event, equipment malfunction, or accident previously evaluated, and would have no significant adverse impact on health and safety of the public or the environment.

(2) Thermal

Events/accidents categorized above as "thermal" include those events/accidents described in Trojan ISFSI SAR Sections 8.1.2, 8.2.2, and 8.2.7. As indicated in SAR Sections 8.1.2.1.3, 8.1.2.2.3, 8.2.2.3, and 8.2.7.3, these events/accidents do not result in radioactive effluent releases or significant adverse radiological consequences. Thus, changing the Controlled Area boundary from 300 meters to 200 meters would have no significant effect on the consequences of these "thermal" events/accidents previously evaluated in the Trojan ISFSI SAR.

(3) Structural

Events/accidents categorized above as "structural" include those events/accidents described in Trojan ISFSI SAR Sections 8.1.1, 8.2.3, 8.2.6, 8.2.10, 8.2.13, and 8.2.14. With the exception of missiles generated by confined explosions associated with use of a natural gas turbine power plant at the Trojan ISFSI site (SAR Section 8.2.14.3), these events/accidents do not result in radioactive effluent releases or significant adverse radiological consequences. Thus, changing the Controlled Area boundary from 300 meters to 200 meters would have no significant effect on the consequences of these events/accidents.

For missile impacts postulated in Trojan ISFSI SAR Section 8.2.14, and also for tornado-generated missile impacts postulated in SAR Section 8.2.4, the radiological consequences of these postulated accidents are minimal for the expected duration of the event. This postulated accident would not result in any release of radioactive material to the environment, but could result in minor damage to the Concrete Cask concrete and thus a localized reduction in radiological shielding. As stated in SAR Sections 8.2.4.3 and 8.2.14.3, it is estimated that shielding materials can be in place within approximately 12 hours. Given the short duration and localized nature of this condition, and with consideration for the measured Trojan ISFSI radiation dose rates described in Section 1 above that were found to be approximately five (5) percent or less of predicted dose rates at approximately equivalent distances/locations, it is reasonably concluded that the radiological consequences of a postulated missile impact are not significantly increased by moving the Controlled Area boundary from 300 meters to 200 meters from the edge of the Storage Pad.

Based on the above evaluation, changing the Controlled Area boundary from 300 meters to 200 meters would have no significant effect on the consequences of these "structural" events/accidents previously evaluated in the Trojan ISFSI SAR.

(4) Natural Phenomena

Accidents categorized above as "natural phenomena" include those accidents described in Trojan ISFSI SAR Sections 8.2.4, 8.2.5, 8.2.11, and 8.2.12. As analyzed in Trojan ISFSI SAR Section 8.2.4, the radiological consequences of a postulated accident involving a tornado-generated missile impact on the cask are minimal for the expected duration of the event. As qualitatively addressed above with regard to missile impacts, it is reasonably concluded that the radiological consequences of a postulated missile impact on the Trojan ISFSI storage casks are not significantly increased by moving the Controlled Area boundary from 300 meters to 200 meters from the edge of the Storage Pad. As indicated in SAR Sections 8.2.5.3 and 8.2.11.3, accidents involving earthquakes or volcanic activity are not anticipated to result in radioactive effluent releases or significant adverse radiological consequences. Thus, changing the Controlled Area boundary from 300 meters to 200 meters would have no significant effect on the consequences of these accidents as previously analyzed. Finally, the radiological consequences of a lightning strike on the Trojan ISFSI casks are shown in Trojan ISFSI SAR Section 8.2.12.3 to be similar or less than the consequences of a tornado missile strike. Thus, changing the Controlled Area boundary from 300 meters to 200 meters would not involve any significant increase in the consequences of this or other "natural phenomena" as previously analyzed in the Trojan ISFSI SAR.

(5) Fires/Explosions

Accidents categorized above as "fires/explosions" include those accidents analyzed in Trojan ISFSI SAR Sections 8.2.8 and 8.2.9. As indicated in Trojan ISFSI SAR Section 8.2.8.3 and 8.2.9, fires and/or explosions at or near the Trojan ISFSI site are not anticipated to result in radioactive effluent releases or significant adverse radiological consequences. Thus, changing the Controlled Area boundary from 300 meters to 200 meters would have no significant effect on the consequences of these accidents involving "fires/explosions" as previously analyzed in the Trojan ISFSI SAR.

Based on the above, it is confirmed that the change in the Controlled Area boundary from 300 meters to 200 meters from the edge of the Storage Pad does not involve an increase in the probability or consequences of an event, equipment malfunction, or accident previously evaluated in the Trojan ISFSI SAR.

C. Determination of No Possibility of New or Different Kind of Event/Malfunction/Accident

The proposed change in the Trojan ISFSI Controlled Area boundary and the associated changes to the shielding analysis as documented in the attached Calculation No. TI-159 do not affect the design or operational characteristics of any ISFSI structure, system, or component. The distance from the ISFSI to the Controlled Area boundary is primarily used as an input parameter for calculating dose consequences to verify compliance with the limits specified in 10 CFR 72.104 and 10 CFR 72.106. The ISFSI Controlled Area and its associated access/traffic control requirements serve to mitigate the consequences of a postulated event/accident. However, changing the Trojan ISFSI Controlled Area boundary to 200 meters as proposed herein does not have any reasonable likelihood of initiating any new event or accident. Thus, the proposed change does not create the possibility of a new or different kind of event, equipment malfunction, or accident from any previously evaluated in the Trojan ISFSI SAR.

D. Evaluation Summary

It is confirmed by the evaluation above that the proposed change in the Controlled Area boundary from 300 meters to 200 meters from the edge of the Storage Pad, and the associated changes to the Trojan ISFSI SAR analyses, do not adversely impact public health and safety. This evaluation confirms that the total radiation doses to an individual on or beyond the proposed Trojan ISFSI Controlled Area boundary at 200 meters during normal and off-normal conditions are projected to be significantly less than the total doses calculated in the current shielding and confinement analyses for the Controlled Area boundary at 300 meters. Thus, these calculated doses are shown to remain well below the dose limits specified in 10 CFR 72.104.

Furthermore, the above evaluation confirms that the total doses to an individual on or beyond the proposed 200-meter Controlled Area boundary due to postulated accidents are not significantly impacted by the changes proposed herein, and thus remain well below the limits specified in 10 CFR 72.106. Finally, the above evaluation confirms that the proposed Controlled Area boundary and associated shielding analysis changes do not involve an increase in the probability or consequences of an event, equipment malfunction, or accident previously evaluated, nor do they create the possibility of a new or different kind of event, equipment malfunction, or accident from any previously evaluated. Therefore, this license amendment request conforms to the standards of 10 CFR 72.46(b)(2) for a determination that the proposed amendment does not present a genuine issue as to whether the health and safety of the public will be significantly affected.

3. Environmental Impact Considerations Determination

As described below, the change to the Controlled Area boundary proposed herein represents a change in operations, such that (i) there is no significant change in the types or significant increase in the amounts of any effluents that may be released offsite, (ii) there is no significant increase in individual or cumulative occupational radiation exposure, (iii) there is no significant construction impact, and (iv) there is no significant increase in the potential for or consequences from radiological accidents. As such, this amendment request satisfies the criteria specified in 10 CFR 51.22(c)(11) for a categorical exclusion from the requirements to perform an environmental assessment or to prepare an environmental impact statement. The specific criteria of 10 CFR 51.22(c)(11) are addressed as follows:

(i) *The proposed amendment does not result in a significant change in the types or significant increase in the amounts of any effluents that may be released offsite.*

As indicated in Section 2 above and in the Trojan ISFSI SAR, normal operation of the Trojan ISFSI does not result in any anticipated effluent release of any type or amount. However, postulated radiological effluent releases under normal, off-normal, and hypothetical accident conditions are analyzed as documented in the Trojan ISFSI SAR. The impacts on these analyses as a result of the Controlled Area boundary change proposed herein are evaluated in Section 2 above, confirming that the proposed amendment does not result in a significant change in the types or significant increase in the amounts of any effluents that may be released offsite.

Specifically, the proposed changes to the Controlled Area boundary and associated shielding analysis changes do not involve any change in the types of effluents that may be released as a result of Trojan ISFSI activities. The changes proposed herein do not affect the design or operational characteristics of any ISFSI structure, system, or component, and do not affect procedures governing ISFSI operational activities that involve the potential for any significant change in types or increase in effluents. Furthermore, as shown in Section 2 above, calculated bounding dose consequences of postulated normal, off-normal, and hypothetical accident effluent releases as previously analyzed in the Trojan ISFSI SAR do not change as a result of the Controlled Area boundary change proposed herein. Thus, the evaluation in Section 2 above supports the conclusion that the proposed amendment does not result in a significant change in the types or significant increase in the amounts of any effluents that may be released offsite.

(ii) *The proposed amendment does not result in a significant increase in individual or cumulative occupational radiation exposure.*

As stated in Section 1 above, the change to the Controlled Area boundary and related changes to the shielding analysis as proposed herein do not impact the current design basis shielding analysis described in Trojan ISFSI SAR Sections 7.3.2.1, 7.3.2.2, and 7.4 as it pertains to predicted occupational dose rates. The changes proposed herein do not affect the design or operational characteristics of any ISFSI structure, system, or component, and do not affect procedures governing ISFSI operational activities that involve the potential for any significant occupational exposures. Therefore, the proposed changes do not impact occupational radiation exposures. The evaluation detailed in Section 2 above confirms that the Controlled Area boundary changes proposed herein will not result in any significant increase in radiation exposure to an individual member of the public as a result of Trojan ISFSI activities/operations. Based on the above, the proposed amendment does not result in a significant increase in individual or cumulative occupational radiation exposure.

(iii) *The proposed amendment does not result in a significant construction impact.*

As indicated in Sections 1 and 2 above, the Controlled Area boundary and associated shielding analysis changes proposed herein do not involve changes to design, construction, or operational characteristics of any ISFSI structure, system, or component. Thus, the proposed amendment does not result in a significant construction impact.

(iv) *The proposed amendment does not result in a significant increase in the potential for or consequences from radiological accidents.*

The evaluation in Section 2 above specifically confirms that the proposed change in the Controlled Area boundary from 300 meters to 200 meters from the edge of the Storage Pad and the associated changes to the shielding analysis do not involve an increase in the probability or consequences of an event, equipment malfunction, or accident previously evaluated in the Trojan ISFSI SAR. The Trojan ISFSI SAR analyses of events, equipment malfunctions, and accidents address postulated and/or hypothetical events/accidents that could result in radiological consequences. Thus, the proposed amendment does not result in a significant increase in the potential for or consequences from radiological accidents.

Based on the preceding analysis, it is concluded that the proposed changes to the Trojan ISFSI Controlled Area boundary and the shielding analysis as incorporated into changes to the Trojan ISFSI SAR satisfy the criteria delineated in 10 CFR 51.22(c)(11) for categorical exclusion from the requirements of an environmental impact statement or environmental assessment. Therefore, pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment is required.

4. Schedule Consideration

PGE requests that 60 days be allowed for implementation of changes proposed herein following approval of this license amendment request.

ATTACHMENT 1 TO
ENCLOSURE I TO VPN-019-2005

Trojan ISFSI (TI) Calculation No. TI-159,
"Calculation to Establish Trojan ISFSI Controlled Area Boundary at 200 Meters"

*** QA RECORD WHEN COMPLETED ***

TROJAN NUCLEAR PLANT/ISFSI CALCULATION COVER SHEET

Sheet 1 Cont'd on Sheet 2

Title: Calculation to Establish Trojan ISFSI Controlled Area Boundary at 200 Meters

Trojan Nuclear Plant/ISFSI

Structure ______

System ______

Component ______

Calculation No. TI-159

Supersedes Calculation No. ______

Quality-Related YES / No

References (PMR/DPMR, SPEER, MR, PSC, etc.) ______

Affected Document No.	Has Been Changed by Identify Change Vehicle: (MR, DPMR, DCP, PCF, SPEER, PSC, etc.)	Or Revision has been Deferred by (Identify Memo, CTL, etc.)	Responsible Supervisor/Date (Deferrals Only)
PGE-1069 PGE-1075 TIP 14		LCA 72-05 (see also LDCR 2005-007)	[signature] 5/4/05

Calculation Objective: Calculate doses based on actual radiation measurements to verify the acceptability of changing the Controlled Area Boundary (CAB) to 200 meters from the edge of the Trojan ISFSI Storage Pad.

Revision Description:

Rev. No.	Preparer	Date	Verified By	Date	Approved By	Date
0	Larry Rocha [signature]	5/03/05	Matt Featherston [signature]	5/4/05	[signature]	5/4/05

Attachment 2
Page 1 of 1

PGE
General Computation Sheet

Subject: Calculation to Establish Trojan ISFSI Controlled Area Boundary at 200 Meters

By: Larry Rocha	Date: 05/03/2005	Chkd. By M. H. Fullerton	Date: 5/4/05

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General Computation Sheet

Subject: Calculation to Establish Trojan ISFSI Controlled Area Boundary at 200 Meters

By: Larry Rocha	Date: 05/03/2005	Chkd. By M. W. Fotheringham	Date: 5/4/05

I. Title: Calculation to Establish Trojan ISFSI Controlled Area Boundary at 200 Meters.

II. Objective: Calculate doses based on actual radiation measurements to verify the acceptability of changing the Controlled Area Boundary (CAB) to 200 meters from the edge of the ISFSI storage pad.

III. Assumptions:

A. Radiation attenuation as a function of distance is the same for the design case as for actual conditions. Air shielding is considered in both calculations. No shielding from earthen berms, buildings or other structures is considered.

B. Any minimal residual radioactivity remaining on the portion of the Trojan site that has been decommissioned under 10 CFR 50 is not sufficient to measurably contribute to dose rate measurements performed in support of this calculation.

C. Background dose rate of 4 μR/hr, measured on April 21, 2005, is subtracted from the measured dose rate (pre-operational background measurements averaged 7 μR/hr).

D. The instrument used to measure the dose rate and background has a ±10 percent uncertainty (estimated error). Multiple readings at different locations and distances will be determined. The readings are multiplied by a factor of 1.1 to correct for a potential error of –10 percent (instrument could read low by 10 percent).

E. The dose rate ratio calculated herein – the ratio of the corrected dose rate measurement to the design dose rate predicted at the proximate distance/location – is reasonably representative for use in dose calculations for other directions/distances than those measured. The original shielding calculation that was used to predict design dose rate-versus-distance values incorporated the same conservatisms for all casks, including an assumption that the ISFSI is uniformly loaded with design basis fuel assemblies. Because the actual characteristics of each individual cask contents (e.g., burnup, cooling time, partial fuel assemblies, etc.) differed from the design assumption by varying amounts, and considering ISFSI geometry specific to each direction, it would be

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By: Larry Rocha	Date: 05/03/2005	Chkd. By M. W. Gutherie	Date: 5/4/05

expected for there to be some small variances in this ratio. However, for the purposes of this calculation, any variance would not be significant enough to adversely impact the conclusions reached, i.e., total doses at a distance of 200 meters from the ISFSI are well below regulatory limits. This conclusion is supported by comparing the results of this calculation (using this assumption) to the 10 CFR 72.104 limits (see Table 2 of this calculation). Such a comparison indicates that the calculated dose rate ratio used herein (0.05) would have to vary by more than 700 percent (i.e., would have to exceed 0.35) to result in calculated total doses at 200 meters from the ISFSI exceeding regulatory limits. Based on the original shielding analysis methodology and results and on the actual cask contents/loading characteristics, there is no reasonable likelihood that such a variance could exist, and thus for the purposes of this calculation, this assumption is determined to be appropriate and adequate.

F. The effluent dose calculation results presented in the Trojan ISFSI Safety Analysis Report (ISFSI SAR), Sections 7.2.2, 8.1.3, 8.1.4, and 8.2.1 (Reference V.A.3), remain valid and bounding for a 200-meter CAB, since the analyses of postulated normal, off-normal, and hypothetical accident radiological effluent releases from the confinement boundary assumes a distance of 200 meters from the ISFSI storage pad to the location where the calculated dose would be received, and the SAR analysis of an event involving an off-normal release of external radioactive contamination assumes a distance of 100 meters. Therefore, establishment of the ISFSI CAB at 200 meters does not require a change to the SAR analyses or the underlying confinement analysis, and does not impact the SAR analysis confirming that accident dose consequences are well below the regulatory limits of 10 CFR 72.106.

IV. Methodology

A. Measure the actual dose rate at four locations, two distances south and two distances west of the ISFSI. Measurements collected by Tom Meek on the afternoon of April 21, 2005 (see Table 1).

B. For each measured dose rate, determine the "net dose rate" by subtracting the background dose rate contribution (per Assumption III.C above).

C. Multiply each net dose rate value by 1.1 to correct for potential instrument error (per Assumption III.D above). The result is the "corrected dose rate."

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By: Larry Rocha	Date: 05/03/2005	Chkd. By [signature]	Date: 5/4/05

D. Using linear interpolation of design dose rate values in Appendix J of Reference V.C, determine for each dose measurement location the associated design dose rate predicted in the current shielding analysis.

E. Determine the ratio of the corrected dose rate versus the design dose rate at each of the four measurement locations.

F. Select the highest dose rate ratio from Step E above.

G. Multiply the design dose rate at 200 meters (from Reference V.A.1) by the dose rate ratio selected in Step F above, and use the result to calculate the annual direct radiation dose at a distance of 200 meters assuming an occupancy rate of 2080 hrs/yr (consistent with Reference V.A.4).

H. Calculate total annual radiation dose for normal and off-normal conditions at a distance of 200 meters from the ISFSI by adding together the following: (1) the annual direct dose calculated in Step G above; and (2) the normal and off-normal effluent release dose contributions as presented in Reference V.A.2.

I. Compare the results of Step H above to the applicable regulatory limits of 10 CFR 72.104, for determination of the acceptability of establishing the Trojan ISFSI CAB at a distance of 200 meters from the edge of the Storage Pad.

V. References

A. PGE-1069, Trojan ISFSI Safety Analysis Report with Holtec MPC:

1. Table 7.3-9, Dose Versus Distance from Radiation Emanating from the ISFSI with Uniform Burnup and Cooling Time of 42,000 MWD/MTU and 9 Years Cooling, Revision 2.

2. Table 7.4-4, Dose Rates at the Controlled Area Boundary and Nearest Resident from Effluent and Direct Radiation During Normal and Off-Normal Conditions.

3. Section 7.2.2, Airborne Radioactive Material Sources, Section 8.1.3, Off-Normal Contamination Release, Section 8.1.4,

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Off-Normal MPC Leakage, and Section 8.2.1, Failure of Fuel Pins with Subsequent Breach of MPC Confinement Boundary.

4. Section 7.6.2, Analysis of Multiple Contribution.

5. Section 8.2.4, Tornado; Section 8.2.12, Lightning; and Section 8.2.14, Natural Gas Turbine Combined Cycle Power Plant Events.

B. Code of Federal Regulations 10 CFR 20.1003 Definitions, 10 CFR 72.104, and 10 CFR 72.106

C. Trojan ISFSI Calculation No. TI-142, Rev. 2, "Holtec Report No. HI-2012749, Shielding Evaluation for the Trojan ISFSI Completion Project," Revision 2.

VI. Calculation

A. Dose rate measurements were collected on April 21, 2005, using a Bicron Microanalyst serial # B009Q, with a calibration due date of December 16, 2005, at location points marked on Figure 1 of this calculation. These locations were chosen due to direct line of sight with the entire ISFSI array with no significant structures or earthen berms in the way.

Table 1
Dose Rate Measurements Results

Direction	Distance (yards)	Measured Dose Rate (μR/hr)	Net Dose Rate (μR/hr)	Corrected Dose Rate (μR/hr)	Design Dose Rate (μR/hr)	Dose Rate Ratios (actual/design)
South	39	50	46	51	1129	0.045
South	71	23	19	21	424	0.050
West	38	45	41	45	1102	0.041
West	57	30	26	29	581	0.050

Highest ratio is 0.050.

B. The dose rate calculated at 200 meters:

(33.7 μR/hr)(0.050) = 1.69 μR/hr = 1.69e-03 mrem/hr

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C. The annual direct dose for 2080 hours occupancy:

(0.00169 mrem/hr)(2080 hr) = 3.5 mrem.

VII. Results

The direct dose rate calculated for a distance of 200 meters from the ISFSI based on actual dose rate measurements is 3.5 mrem/year, compared to the original shielding analysis design dose rate value of 18.4 mrem/year calculated for the 300-meter Trojan ISFSI Controlled Area boundary.

Total doses at 200 meters for normal/off-normal conditions are listed in Table 2.

Table 2
Normal + Off-Normal Doses at 200 Meters, 2080 Hours/Year

	Dose Rate From Effluent Release (mrem/year)	Direct Dose Rate (mrem/year)	Total Dose Rate (mrem/year)	Regulatory Limit (mrem/year)
Whole Body	0.133	3.5	3.6	25
Thyroid	0.012	3.5	3.5	75
Critical Organ (maximum)	1.58	3.5	5.1	25

VIII. Acceptance Criteria

Acceptance criteria establishing dose limits at the ISFSI Controlled Area boundary are provided in 10 CFR 72.104 and 10 CFR 72.106.

Maximum annual doses from direct radiation and normal and off-normal releases at the Controlled Area boundary cannot exceed regulatory limits of 10 CFR 72.104. As shown in Table 2 above, the total dose rates calculated for the Trojan ISFSI are well below these limits, confirming the acceptability of changing the Trojan ISFSI CAB from 300 meters to 200 meters from the edge of the Storage Pad.

As indicated in Step III.F above, the regulatory dose limits of 10 CFR 72.106 apply to accident dose consequences. With one exception, any radiological consequences of accidents analyzed in the Trojan ISFSI SAR are due only to

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postulated or hypothetical effluent releases. For these analyses, moving the Controlled Area boundary from 300 meters to 200 meters does not require a change to calculated accident (effluent release) dose consequences since these are already calculated in the current Trojan ISFSI SAR analyses for a distance of 200 meters (conservative considering the 300-meter CAB).

The one exception cited above which represents an accident condition that involves a direct dose component at the CAB is Concrete Cask damage due to missile impact or lightning. As stated in the ISFSI SAR (Reference V.A.5), the radiological consequences of these postulated accidents are minimal for the expected duration of the event. These postulated accidents would not result in any release of radioactive material to the environment, but could result in minor damage to the Concrete Cask concrete and thus a localized reduction in radiological shielding. As stated in ISFSI SAR Sections 8.2.4.3 and 8.2.14.3 (Reference V.A.5), it is estimated that shielding materials can be in place within approximately 12 hours. Given the short duration and localized nature of this condition, and with consideration for the measured Trojan ISFSI radiation dose rates that were found to be approximately 5 percent or less of predicted dose rates at equivalent distances/locations, it is reasonably concluded that the radiological consequences of a postulated missile impact are not significantly increased by moving the CAB from 300 meters to 200 meters from the edge of the Storage Pad.

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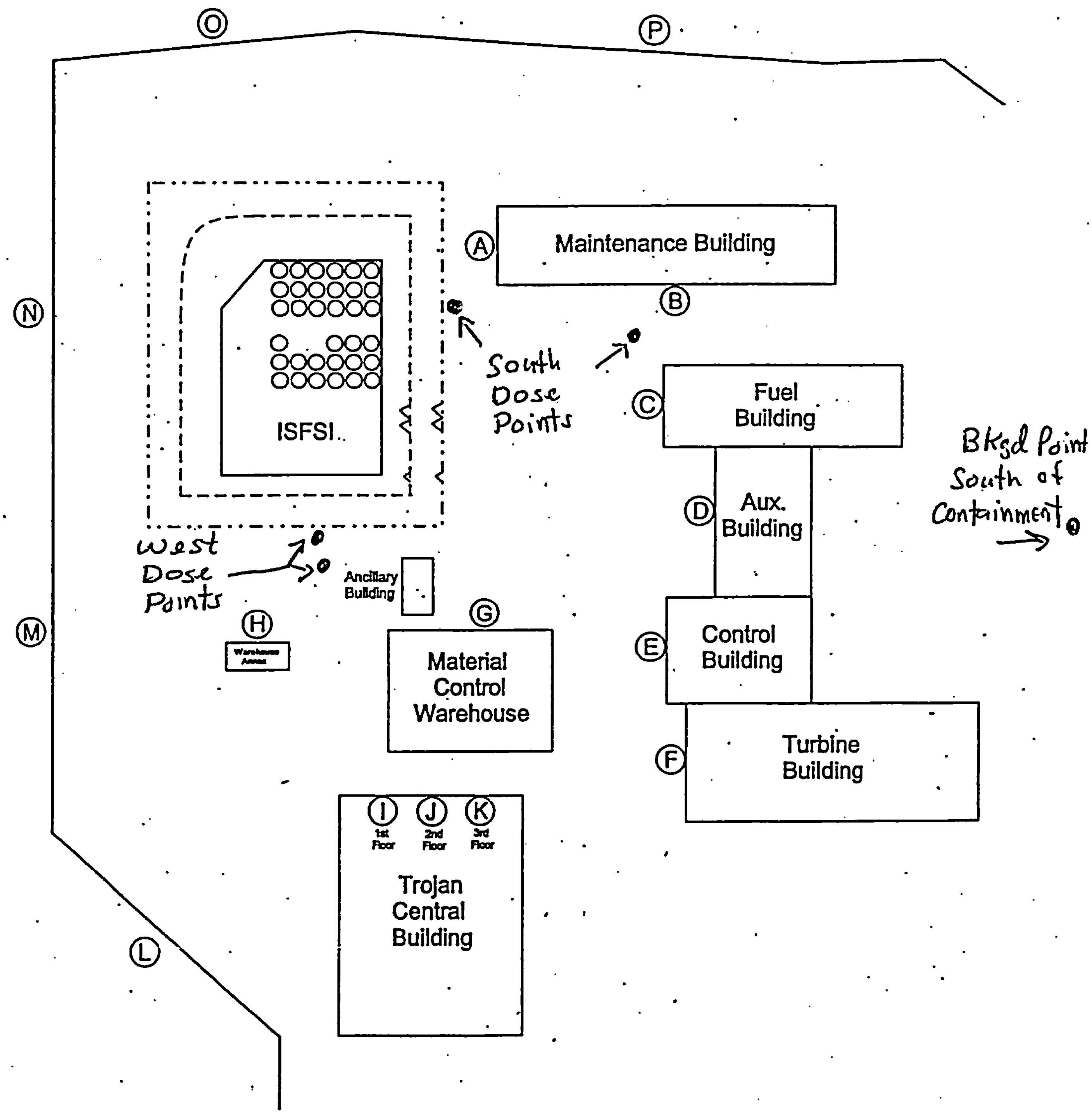
Subject: Calculation to Establish Trojan ISFSI Controlled Area Boundary at 200 meters

By: Larry Rocha	Date: 05/03/2005	Chkd. By W.W. Featherston	Date: 5/4/05

Figure 1

Measurement (Dose Points) Locations



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Subject: Calculation to Establish Trojan ISFSI Controlled Area Boundary at 200 Meters

By: Larry Rocha	Date: 05/03/2005	Chkd. By M.W. Featherston	Date: 5/4/05

Attachments.

Copies of the following referenced documents are attached:

1. ISFSI SAR Tables 7.3-9 and 7.4-4.
2. Pages J-13 and J-19 from TI-142.
3. 10 CFR 72.104.
4. 10 CFR 72.106.

Table 7.3-9

Dose Versus Distance From Radiation Emanating From The ISFSI With Uniform Burnup And Cooling Time Of 42,000 MWD/MTU And 9 Years Cooling

Meters	Feet	Sides of Casks (mrem/hr)	Tops of Casks (mrem/hr)	Total ISFSI Dose (mrem/hr)
4.572	15	7.90E+00	1.08E+00	8.98E+00
15.24	50	2.78E+00	7.24E-01	3.50E+00
30.48	100	9.53E-01	4.39E-01	1.39E+00
45.72	150	4.49E-01	2.90E-01	7.39E-01
60.96	200	2.61E-01	2.03E-01	4.64E-01
100	328.08	8.86E-02	9.31E-02	1.82E-01
150	492.13	3.22E-02	4.06E-02	7.29E-02
200	656.17	1.41E-02	1.96E-02	3.37E-02
250	820.21	6.80E-03	9.87E-03	1.67E-02
260	853.02	6.00E-03	8.67E-03	1.47E-02
270	885.83	5.29E-03	7.62E-03	1.29E-02
280	918.64	4.67E-03	6.70E-03	1.14E-02
290	951.44	4.12E-03	5.90E-03	1.00E-02
300	984.25	3.65E-03	5.20E-03	8.85E-03
310	1017.06	3.25E-03	4.59E-03	7.84E-03
320	1049.87	2.89E-03	4.06E-03	6.95E-03
330	1082.68	2.57E-03	3.58E-03	6.15E-03
340	1115.49	2.29E-03	3.17E-03	5.45E-03
350	1148.29	2.04E-03	2.80E-03	4.84E-03

Table 7.4-4

Dose Rates at the Controlled Area Boundary and Nearest Resident from Effluent and Direct Radiation During Normal and Off-Normal Conditions

(Casks Assumed to Have Uniform Burnup And Cooling Time Of 42,000 MWD/MTU And 9 Years Cooling)

Controlled Area Boundary at 300 Meters
2080 Hours/Year

	Dose Rate from Effluent Release (mrem/year)	Direct Dose Rate (mrem/year)	Total Dose Rate (mrem/year)	Regulatory Limit (mrem/year)
10CFR72.104(a) – Normal + Off-Normal				
Whole Body ADE	0.133	18.4	18.533	25
Thyroid ADE	0.012	18.4	18.4	75
Critical Organ ADE (Max)	1.58	18.4	19.98	25
ADE: Annual Dose Equivalent				

Nearest Resident At 660 Meters
8760 Hours/Year

	Dose Rate from Effluent Release (mrem/year)	Direct Dose Rate (mrem/year)	Total Dose Rate (mrem/year)	Regulatory Limit (mrem/year)
10CFR72.104(a) – Normal + Off-Normal				
Whole Body ADE	0.084	2.19	2.27	25
Thyroid ADE	0.007	2.19	2.20	75
Critical Organ ADE (Max)	0.969	2.19	3.16	25
ADE: Annual Dose Equivalent				

West side all

shading factors

col/row	1	2	3	4	5	6
6	shade	shade	shade	shade	shade	shade
5	shade	shade	shade	shade	shade	shade
4	shade1	shade1	shade1	shade1	shade1	shade1
3	shade			shade	shade	shade
2	shade	shade	shade	shade	shade	shade
1	full	full	full	full	full	full

$\frac{4}{30}(-0.324) + 1.15 = 1102 \mu r/hr$

		mr/hour			mr/2080hr	
feet	meters	side dose	top dose	total dose	total dose	top/total
15.00	4.57	9.24E+00	1.05E+00	1.03E+01	2.14E+04	10.22%
20.00	6.10	7.38E+00	9.95E-01	8.37E+00	1.74E+04	11.88%
50.00	15.24	2.73E+00	6.96E-01	3.43E+00	7.13E+03	20.31%
75.00	22.86	1.47E+00	5.32E-01	2.00E+00	4.17E+03	26.53%
100.00	30.48	8.97E-01	4.19E-01	1.32E+00	2.74E+03	31.82%
114' 110.00	33.53	7.69E-01	3.84E-01	1.15E+00	2.40E+03	33.30%
140.00	42.67	4.87E-01	2.99E-01	7.86E-01	1.63E+03	38.06%
150.00	45.72	4.23E-01	2.77E-01	7.00E-01	1.46E+03	39.58%
171' 160.00	48.77	3.77E-01	2.58E-01	6.35E-01	1.32E+03	40.57%
200.00	60.96	2.45E-01	1.94E-01	4.39E-01	9.13E+02	44.20%
240.00	73.15	1.73E-01	1.50E-01	3.23E-01	6.71E+02	46.45%
260.00	79.25	1.45E-01	1.33E-01	2.78E-01	5.77E+02	47.73%
100m - 328.08	100.00	8.27E-02	8.94E-02	1.72E-01	3.58E+02	51.93%
492.13	150.00	3.03E-02	3.92E-02	6.95E-02	1.45E+02	56.42%
574.15	175.00	2.00E-02	2.71E-02	4.71E-02	9.80E+01	57.57%
656.17	200.00	1.33E-02	1.89E-02	3.23E-02	6.71E+01	58.70%
688.98	210.00	1.15E-02	1.65E-02	2.80E-02	5.81E+01	58.92%
738.19	225.00	9.19E-03	1.34E-02	2.26E-02	4.69E+01	59.26%
754.59	230.00	8.54E-03	1.25E-02	2.10E-02	4.37E+01	59.38%
787.40	240.00	7.40E-03	1.09E-02	1.83E-02	3.81E+01	59.59%
820.21	250.00	6.43E-03	9.56E-03	1.60E-02	3.33E+01	59.76%
853.02	260.00	5.68E-03	8.40E-03	1.41E-02	2.93E+01	59.67%
885.83	270.00	5.01E-03	7.38E-03	1.24E-02	2.58E+01	59.58%
918.64	280.00	4.42E-03	6.49E-03	1.09E-02	2.27E+01	59.50%
951.44	290.00	3.91E-03	5.72E-03	9.62E-03	2.00E+01	59.41%
984.25	300.00	3.46E-03	5.04E-03	8.50E-03	1.77E+01	59.32%
1017.06	310.00	3.08E-03	4.45E-03	7.53E-03	1.57E+01	59.14%
1049.87	320.00	2.74E-03	3.93E-03	6.67E-03	1.39E+01	58.95%
1082.68	330.00	2.44E-03	3.47E-03	5.91E-03	1.23E+01	58.77%
1115.49	340.00	2.17E-03	3.07E-03	5.24E-03	1.09E+01	58.58%
1148.29	350.00	1.93E-03	2.71E-03	4.65E-03	9.67E+00	58.39%

$\frac{11}{40}(-0.196) + 0.635 = 581 \mu r/hr$

South side all

shading factors

col/row	1	2	3	4	5	6
6	shade	shade	shade1	shade1	shade	shade
5	shade	shade		shade1	shade	shade
4	shade	shade		shade1	shade	shade
3	shade	shade	shade1	shade1	shade	shade
2	shade	shade	shade1	shade1	shade	shade
1	full	full	full	full	full	full

		mr/hour			mr/2080hr	
feet	meters	side dose	top dose	total dose	total dose	top/total
15.00	4.57	7.90E+00	1.08E+00	8.98E+00	1.87E+04	12.05%
20.00	6.10	6.71E+00	1.02E+00	7.73E+00	1.61E+04	13.23%
50.00	15.24	2.78E+00	7.24E-01	3.50E+00	7.29E+03	20.67%
75.00	22.86	1.54E+00	5.56E-01	2.10E+00	4.37E+03	26.51%
100.00	30.48	9.53E-01	4.39E-01	1.39E+00	2.90E+03	31.52%
110.00	33.53	8.14E-01	4.02E-01	1.22E+00	2.53E+03	33.05%
140.00	42.67	5.15E-01	3.13E-01	8.28E-01	1.72E+03	37.82%
150.00	45.72	4.49E-01	2.90E-01	7.39E-01	1.54E+03	39.20%
160.00	48.77	4.01E-01	2.69E-01	6.70E-01	1.39E+03	40.18%
200.00	60.96	2.61E-01	2.03E-01	4.64E-01	9.65E+02	43.78%
240.00	73.15	1.85E-01	1.57E-01	3.41E-01	7.10E+02	45.84%
260.00	79.25	1.55E-01	1.38E-01	2.93E-01	6.10E+02	47.03%
328.08	100.00	8.86E-02	9.31E-02	1.82E-01	3.78E+02	51.24%
492.13	150.00	3.22E-02	4.06E-02	7.29E-02	1.52E+02	55.79%
574.15	175.00	2.12E-02	2.81E-02	4.93E-02	1.03E+02	56.94%
656.17	200.00	1.41E-02	1.96E-02	3.37E-02	7.01E+01	58.10%
688.98	210.00	1.22E-02	1.70E-02	2.92E-02	6.08E+01	58.32%
738.19	225.00	9.75E-03	1.38E-02	2.36E-02	4.91E+01	58.65%
754.59	230.00	9.06E-03	1.29E-02	2.20E-02	4.57E+01	58.77%
787.40	240.00	7.83E-03	1.13E-02	1.91E-02	3.97E+01	59.00%
820.21	250.00	6.80E-03	9.87E-03	1.67E-02	3.47E+01	59.20%
853.02	260.00	6.00E-03	8.67E-03	1.47E-02	3.05E+01	59.11%
885.83	270.00	5.29E-03	7.62E-03	1.29E-02	2.69E+01	59.01%
918.64	280.00	4.67E-03	6.70E-03	1.14E-02	2.37E+01	58.93%
951.44	290.00	4.12E-03	5.90E-03	1.00E-02	2.08E+01	58.84%
984.25	300.00	3.65E-03	5.20E-03	8.85E-03	1.84E+01	58.76%
1017.06	310.00	3.25E-03	4.59E-03	7.84E-03	1.63E+01	58.58%
1049.87	320.00	2.89E-03	4.06E-03	6.95E-03	1.44E+01	58.39%
1082.68	330.00	2.57E-03	3.58E-03	6.15E-03	1.28E+01	58.21%
1115.49	340.00	2.29E-03	3.17E-03	5.45E-03	1.13E+01	58.02%
1148.29	350.00	2.04E-03	2.80E-03	4.84E-03	1.01E+01	57.83%

10 CFR 72.104 Criteria for radioactive materials in effluents and direct radiation from an ISFS - Microsoft Internet Explorer p

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Home > Electronic Reading Room > Document Collections > NRC Regulations (10 CFR) > Part Index > § 72.104 Criteria for radioactive materials in effluents and direct radiation from an ISFSI or MRS.

§ 72.104 Criteria for radioactive materials in effluents and direct radiation from an ISFSI or MRS.

(a) During normal operations and anticipated occurrences, the annual dose equivalent to any real individual who is located beyond the controlled area must not exceed 0.25 mSv (25 mrem) to the whole body, 0.75 mSv (75 mrem) to the thyroid and 0.25 mSv (25 mrem) to any other critical organ as a result of exposure to:

(1) Planned discharges of radioactive materials, radon and its decay products excepted, to the general environment,

(2) Direct radiation from ISFSI or MRS operations, and

(3) Any other radiation from uranium fuel cycle operations within the region.

(b) Operational restrictions must be established to meet as low as is reasonably achievable objectives for radioactive materials in effluents and direct radiation levels associated with ISFSI or MRS operations.

(c) Operational limits must be established for radioactive materials in effluents and direct radiation levels associated with ISFSI or MRS operations to meet the limits given in paragraph (a) of this section.

[53 FR 31658, Aug. 19, 1988, as amended at 63 FR 54562, Oct. 13, 1998]

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10 CFR 72.106 Controlled area of an ISFSI or MRS. - Microsoft Internet Explorer provided by PGE

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§ 72.106 Controlled area of an ISFSI or MRS.

(a) For each ISFSI or MRS site, a controlled area must be established.

(b) 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 0.05 Sv (5 rem), or the sum of the deep-dose equivalent and the committed dose equivalent to any individual organ or tissue (other than the lens of the eye) of 0.5 Sv (50 rem). The lens dose equivalent may not exceed 0.15 Sv (15 rem) and the shallow dose equivalent to skin or any extremity may not exceed 0.5 Sv (50 rem). The minimum distance from the spent fuel, high-level radioactive waste, or reactor-related GTCC waste handling and storage facilities to the nearest boundary of the controlled area must be at least 100 meters.

(c) The controlled area may be traversed by a highway, railroad or waterway, so long as appropriate and effective arrangements are made to control traffic and to protect public health and safety.

[53 FR 31658, Aug. 19, 1988, as amended at 63 FR 54562, Oct. 13, 1998; 66 FR 51842, Oct. 11, 2001]

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ATTACHMENT 2 TO
ENCLOSURE I TO VPN-019-2005

Description of and Reason for Changes to the Trojan ISFSI Safety Analysis Report

Description of and Reason for Changes to the Trojan Independent Spent Fuel Storage Installation (ISFSI) Safety Analysis Report

Description of Trojan ISFSI SAR Change	Reason for Trojan ISFSI SAR Change
• Section 2.1.2	
– In the next-to-last paragraph, the distance from the Storage Pad edge to the Controlled Area boundary is changed from 300 meters to 200 meters. References to the Portland & Western Railroad are eliminated.	– These changes reflect the change in the Trojan ISFSI Controlled Area as discussed above. With the Controlled Area boundary pulled back to 200 meters, the Portland & Western Railroad no longer will traverse the Trojan ISFSI Controlled Area. Thus, the formal agreement PGE maintains with the railroad pursuant to 10 CFR 72.106(c), enabling PGE to restrict rail traffic in the event of an ISFSI emergency, is no longer necessary and may be eliminated.
– In the next-to-last paragraph, clarification is added with regard to PGE's agreement with the state of Oregon regarding control of tidelands.	– This change clarifies that PGE, rather than the state of Oregon, would evacuate persons from tidelands in the event of an ISFSI emergency.
• Section 2.3.4	
– In the first two paragraphs, the distance specified for the Controlled Area boundary is changed from 300 meters to 200 meters. The statements regarding the conservatism reflected in using diffusion estimates for a distance less than the Controlled Area boundary distance are revised/eliminated as appropriate. Editorial rewording is added for readability.	– With the new Controlled Area boundary at 200 meters, use of a 200-meter diffusion estimate (also referred to as "atmospheric dispersion factor", or χ/Q) remains appropriate. It is noted that this change effectively eliminates the conservatism currently employed in the Trojan ISFSI SAR analysis of using a 200-meter diffusion estimate for dose estimates at 300 meters. However, with calculated doses at the 200-meter Controlled Area boundary well below regulatory limits, this conservatism is not necessary to ensure health and safety of the public and the environment.
– A new paragraph is added at the end of this section to incorporate the short-term diffusion estimate at 100 meters.	– This additional paragraph ensures completeness, and clarifies the difference in the various diffusion estimates used in the Trojan ISFSI SAR analyses.

Description of Trojan ISFSI SAR Change	Reason for Trojan ISFSI SAR Change
• Figure 2.1-2	
– The depiction of the Trojan ISFSI Controlled Area boundary is redrawn to approximate scale.	– This change graphically reflects the change in the Controlled Area boundary from 300 meters to 200 meters from the edge of the Storage Pad.
• Section 3.3.5.3	
– In the second paragraph, changes are made to refer to Chapter 7 for additional detail, and to clarify the basis for the dose rate specified as calculated for 100 meters.	– These changes are made to conform to more extensive changes made in Chapter 7 of the Trojan ISFSI SAR as detailed further below. Specifically, the proposed SAR Chapter 7 revision incorporates the results of two direct radiation dose calculations: one the original shielding analysis results based on ISFSI loading of design basis fuel, and the other the results of Calculation No. TI-159 for establishment of the 200-meter Controlled Area boundary based on actual radiation dose rate measurements. The changes to SAR Section 3.3.5.3 clarify which of these dose calculations support the dose rate specified for 100 meters.
• Section 7.2.2.2.8	
– The distance specified for the Controlled Area boundary is changed from 300 meters to 200 meters. The statement regarding the conservatism reflected in using an atmospheric dispersion factor for a distance less than the Controlled Area boundary distance is eliminated. Editorial rewording is added for readability.	– As discussed above for changes to Section 2.3.4, with the new Controlled Area boundary at 200 meters, use of a 200-meter diffusion estimate remains appropriate. Also as discussed previously, this change effectively eliminates the conservatism currently employed in the Trojan ISFSI SAR analysis of using a 200-meter diffusion estimate for dose estimates at 300 meters. However, with calculated doses at the 200-meter Controlled Area boundary well below regulatory limits, this conservatism is not necessary to ensure health and safety of the public and the environment.

Description of Trojan ISFSI SAR Change	Reason for Trojan ISFSI SAR Change
• Section 7.2.2.3	
– A callout is added reflecting new Reference 26.	– This change reflects the addition of new Reference 26 to SAR Section 7.7. Reference 26 is Calculation No. TI-159, which (in combination with the results of the original Trojan ISFSI confinement and shielding analyses) documents the supporting dose calculation for establishing the Trojan ISFSI Controlled Area boundary at 200 meters from the edge of the Storage Pad.
• Section 7.3.2	
– In the first paragraph, the distance specified for the Controlled Area boundary is changed from 300 meters to 200 meters. Editorial rewording is added for readability, and to refer to new SAR Section 7.3.2.3.	– These changes reflect the change in the Trojan ISFSI Controlled Area as discussed above. As detailed further below, new Trojan ISFSI SAR Section 7.3.2.3 summarizes the basis for establishing the Trojan ISFSI Controlled Area boundary at 200 meters.
• Section 7.3.2.3 (new)	
– This new SAR section is added to summarize the basis for establishing the Trojan ISFSI Controlled Area boundary at 200 meters from the edge of the Storage Pad. This new section also describes the relationship between the original shielding analysis results and the results of new Calculation No. TI-159.	– This new section provides context for the change to the Controlled Area boundary distance, especially with consideration for the fact that the original shielding analysis remains bounding for occupational and nearest resident dose estimates, but no longer (on its own) provides the (direct dose portion of the) basis for the Controlled Area boundary.

Description of Trojan ISFSI SAR Change	Reason for Trojan ISFSI SAR Change
• Section 7.6.2	
– In the second paragraph, the distance specified for the Controlled Area boundary is changed from 300 meters to 200 meters. The fourth sentence of this paragraph, regarding the conservatism reflected in using an atmospheric dispersion factor for a distance less than the Controlled Area boundary distance, is reworded.	– These changes reflect the change in the Trojan ISFSI Controlled Area as discussed above. As discussed above for changes to Sections 2.3.4 and 7.2.2.2.8, use of the 200-meter atmospheric dispersion factor for the 200-meter Controlled Area boundary effectively eliminates the conservatism currently employed in the Trojan ISFSI SAR analysis of using the 200-meter atmospheric dispersion factor for dose estimates at the 300-meter boundary. However, with calculated doses at the 200-meter Controlled Area boundary well below regulatory limits, this conservatism is not necessary to ensure health and safety of the public and the environment.
• Section 7.6.3	
– Clarification is added to the first paragraph that Table 7.4-4 contains dose information for both the Controlled Area boundary and the nearest resident.	– This change clarifies the contents of Table 7.4-4 in support of further changes to the third paragraph and Table 7.4-4 as detailed below.
– The third paragraph is revised to reflect the fact that the dose results in Table 7.4-4 for the Controlled Area boundary and the nearest resident are based on different assumptions.	– With the changes supported in Calculation No. TI-159, the dose estimate at the Controlled Area boundary is based on actual dose rate measurements, and no longer relies on the shielding analysis assumption regarding characteristics of the cask contents. The nearest resident dose estimate remains based on the original shielding analysis assumption that all casks are loaded with contents having uniform burnup and cooling time (i.e., design basis fuel). The changes to this paragraph reflect these changes.
• Section 7.7	
– A new Reference 26 is added for Calculation No. TI-159.	– This addition incorporates Calculation No. TI-159 as a design basis calculation in support of establishing the Trojan ISFSI Controlled Area boundary at 200 meters.

Description of Trojan ISFSI SAR Change	Reason for Trojan ISFSI SAR Change
• Table 7.2-11 – The distance designated for the Controlled Area boundary is changed from 300 meters to 200 meters.	– This change reflects the change in the Trojan ISFSI Controlled Area as discussed above. As described previously, with the new Controlled Area boundary at 200 meters, use of the 200-meter diffusion estimate remains appropriate.
• Table 7.4-2 – The distance designated for the Controlled Area boundary is specified as 200 meters.	– This clarifying change reflects the change in the Trojan ISFSI Controlled Area as discussed above.
• Table 7.4-4 – The dose rates at the Controlled Area boundary due to direct radiation are updated, and the total doses adjusted accordingly. The Controlled Area boundary is clarified to be at 200 meters, and the basis for the Controlled Area boundary dose rate values (actual measurements) is specified.	– These changes reflect the results of Calculation No. TI-159, which documents the basis for the changes to the dose calculation results at the Controlled Area boundary.
• Section 8.1.3.1.3 – In the fourth paragraph, the distance specified for the Controlled Area boundary is changed from 300 meters to 200 meters. The paragraph is further revised to clarify that this distance is from the edge of the Storage Pad.	– This change reflects the change in the Trojan ISFSI Controlled Area as discussed above.

Description of Trojan ISFSI SAR Change	Reason for Trojan ISFSI SAR Change
• Sections 8.2.4.3 and 8.2.14.3	
– The last paragraph is changed to specify the new Controlled Area boundary distance of 200 meters, and to reference the dose rate calculation (based on actual dose rate measurements) described in new Trojan ISFSI SAR Section 7.3.2.3.	– These changes reflect the results of Calculation No. TI-159, which documents the basis for the changes to the dose calculation results at the Controlled Area boundary.
• Table 8.2-6	
– The distance specified in the table for the Controlled Area boundary is changed from 300 meters to 200 meters.	– These changes reflect the change in the Trojan ISFSI Controlled Area as discussed above.

ENCLOSURE II
TO VPN-019-2005

Proposed Revision to the Trojan ISFSI Safety Analysis Report

With Changes Annotated by Strikethroughs, Insertions, And Margin Sidebars

Four 230kV overhead transmission lines terminate in a switchyard approximately 1000 feet from the ISFSI. The switchyard supplies power to the ISFSI site.

The Controlled Area, as defined in 10 CFR 72.106, immediately surrounds the ISFSI and extends out to ~~300~~ *200* meters from the edge of the Storage Pad (Figure 2.1-2). The Controlled Area lies entirely on PGE property with the exception of a portion of the Controlled Area that extends over the Columbia River ~~and the Portland & Western Railroad, Inc. right-of-way~~. U.S. Highway 30 is not within the Controlled Area. PGE has formal agreements with ~~Portland & Western Railroad, Inc. to restrict traffic over their right-of-way, with~~ the U.S. Coast Guard to restrict traffic on the Columbia River, and with the state of Oregon to *enable PGE to* evacuate persons from publicly owned lands (i.e., tidelands) in the event of an emergency at the ISFSI.

The doses that could be anticipated at the Controlled Area boundary from an off-normal event or accident are discussed in Chapter 8 and are below the limits of 10 CFR 72.106 and Oregon Administrative Rule (OAR) 345-026-0390.

2.1.2.1 Other Activities Within the ISFSI Site Boundary

No activities unrelated to ISFSI operation are performed within the ISFSI controlled access area boundary.

Several major physical facilities, which were used during Trojan Nuclear Plant operation, are grouped to the south and west of the ISFSI site. These facilities are outside the ISFSI controlled access area and are intended to be made available for commercial activities upon their release for unrestricted use. Leases issued to commercial users of these facilities will limit activities to ensure that postulated events and accident analyses remain bounding. Access to these facilities will not afford access to the ISFSI.

2.1.2.2 Boundaries for Establishing Effluent Release Limits

The only potential effluent release points are the Concrete Casks themselves located at the ISFSI. The analyses presented in the HI-STORM FSAR (Reference 14) demonstrate that the MPC remains intact during all postulated off-normal and accident conditions. In summary, there is no mechanistic failure that results in a breach of the confinement boundary. However, the dose resulting from an effluent release due to a non-mechanistic ground-level breach of the confinement boundary during normal operation and anticipated occurrences (i.e., direct radiation) has been estimated at the Controlled Area boundary and is within the limits specified in 10 CFR 72.104 and OAR 345-026-0390.

The Restricted Area, as defined in 10 CFR 20, has the same boundaries as the controlled access area that surrounds the ISFSI Protected Area. Physical access to the Restricted Area is restricted by the controlled access area fence. Access into the Protected Area is controlled as described in

Meteorological data were collected during nuclear plant operation and for a time during defueled operation, but data will not be collected during ISFSI operation. The source terms for ISFSI operation are much lower than the source terms for nuclear plant operation. Accidents and off-normal events do not result in releases that would exceed 10 CFR 72.106 limits and OAR 345-026-0390. As a result, meteorological monitoring for the calculation of off-site doses from normal operation and accident conditions is not necessary. These doses can be effectively calculated by using conservative values for atmospheric dispersion (χ/Q) from the onsite historical data.

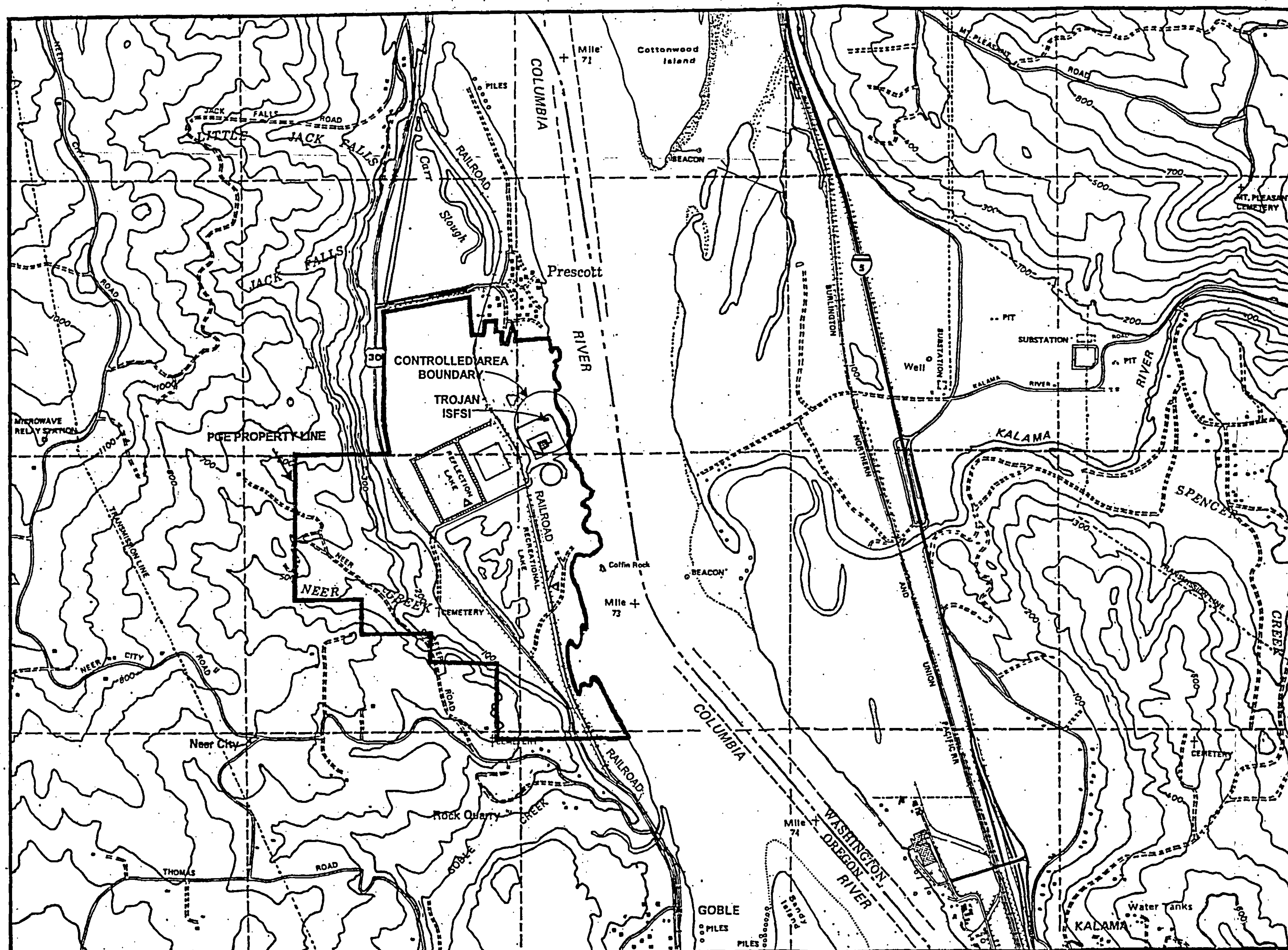
As stated above, meteorological data for the site during the period September 1, 1971 through August 31, 1974 compared favorably with National Weather Service data for Portland, Oregon. Hence, if real time meteorological data is desired, then data from the National Weather Service for Portland could be used.

2.3.4 DIFFUSION ESTIMATES

~~Diffusion estimates were made for 3-30 day average conditions only.~~ Worst case postulated long-term (routine) releases associated with operation of the ISFSI were modeled using a 50% probability diffusion value. The long-term diffusion estimate *using 3- to 30-day average conditions* is 3.75E-05 sec/m^3 at 200 meters. Determination of the long-term diffusion value at 200 meters is ~~conservative~~ *appropriate* since the Trojan ISFSI Controlled Area Boundary is at ~~300~~ *200* meters.

A hypothetical accident was also postulated to determine the concentrations and doses that could occur following the release. The ~~30-day~~ *30-day* accident diffusion estimate is obtained from the Trojan Nuclear Plant Safety Analysis Report. The hypothetical accident χ/Q at 200 meters is 3.25E-04 sec/m^3~~, which as stated above is conservative since the Trojan ISFSI Controlled Area Boundary is at 300 meters~~.

The atmospheric diffusion factor for the off-normal release of external contamination is calculated as described in Section 8.1.3.1.3 assuming a two-hour release period consistent with a short-duration release. The short-duration diffusion estimate at 100 meters is 3.5E-02 sec/m^3. Determination of the short-duration diffusion value at 100 meters is conservative since the Trojan ISFSI Controlled Area Boundary is at 200 meters.



SCALE IN MILES
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TROJAN ISFSI
SAFETY ANALYSIS REPORT

FIGURE 2.1-2
PGE PROPERTY, ISFSI SITE, AND CONTROLLED AREA BOUNDARY
LCA 72-05 Proposed Revision

design results in an average external side surface dose (gamma and neutron) of less than 100 mrem/hr on the sides and 300 mrem/hr on the top and at the air vents.

Expected dose rates associated with ISFSI operations are contained in Section 7.4.

3.3.5.3 Radiological Alarm Systems

The Concrete Cask system does not produce routine solid, liquid, or gaseous effluents. Section 8.1.3 discusses an inadvertent release of surface contamination from the exterior of the MPC. The consequences of this event are negligible (2.50 mrem at 100 meters). Therefore, an alarm for airborne radioactivity is not required to protect personnel or the environment.

As discussed in Chapter 7, ~~T~~*t*he estimated working dose rate for the Concrete Cask (maximum fuel burnup) is 9.9 mrem/hr, and the highest dose rate at 100 meters from the edge of the ISFSI Storage Pad is calculated *(based on the entire ISFSI uniformly loaded with design basis fuel assemblies)* to be 0.18 mrem/hr. These dose rates do not warrant a radiation alarm to protect personnel or the environment.

Based on the above, radiological alarms are not required for the Trojan ISFSI.

3.3.6 FIRE AND EXPLOSION PROTECTION

The potential for fires at the ISFSI are minimized by the use of paved open areas and minimum combustible materials within the ISFSI security fence. As discussed in Section 2.2.3.3 the facility is well protected from industrial and forest fires by natural barriers. Sections 8.2.9 and 8.2.14.2.2 provide additional discussion on fires.

Explosion analyses for the ISFSI are presented in Sections 8.2.8, 8.2.14.2.3 and 8.2.14.2.4.

3.3.7 MATERIALS HANDLING AND STORAGE

3.3.7.1 Spent Fuel Handling and Storage

The loading of each MPC is limited to the design basis maximum decay heat load limit shown in Table 3.1-3 (Reference 8). The Trojan Storage System is designed to accommodate the design basis maximum decay heat load and maintain fuel cladding temperature below limits established for inert dry storage (Reference 4). In addition, temperature limits for storage system components are also maintained below design limits. The Technical Specifications establish surveillances to preclude exceeding material design temperature limits.

The fuel clad temperature limit is a function of fuel burnup, fuel pin fill gas pressure, and fuel age. For the Trojan ISFSI, the fuel clad temperature limit is shown in Table 3.1-3. This limit was determined using Westinghouse 17x17 fuel with a limiting combination of cooling time and burnup to produce the highest decay heat emission rate, as shown in Table 3.1-3. This fuel is

7.2.2.2.7 Radionuclide Release Rate

The radionuclide release rate is the product of the quantity of isotopes available for release to the MPC cavity, the fraction of volume released per unit time, and the release fraction.

Volatiles/Fines/Gases/Crud

$$\text{Release Rate } (Q_i) = \frac{A_i(\text{Ci}) \times f_b \times [f_v \text{ or } f_f \text{ or } f_c \text{ or } f_g] \times L_{ts}(\frac{\text{cm}^3}{\text{sec}})}{V_b(\text{cm}^3)}$$

where:

A_i	=	MPC activity of nuclide i (see Table 7.2-1)
L_{ts}	=	MPC leak rate under normal conditions = 7.37×10^{-6} (cm^3/sec)
V_b	=	MPC internal free volume = 5.96×10^6 (cm^3)
L_{ts}/V_b	=	the fraction of volume released per second
f_b, f_v, f_f, f_c, f_g	=	See Table 7.2-12 for definitions

7.2.2.2.8 Atmospheric Dispersion Factor

For the evaluation for normal conditions of storage of the annual dose due to an effluent release at the Controlled Area boundary and the nearest resident, the χ/Q atmospheric dispersion factors are provided in Table 7.2-11. The χ/Q *value for 200 meters was* used for *the dose calculation at* the ~~300~~*200*-meter Controlled Area boundary~~-was the value for 200 meters~~. ~~This is conservative since the χ/Q is higher and, therefore, the calculated dose is higher for the shorter distance.~~ The χ/Q value for 600 meters was used for the dose calculation at the location of the nearest resident.

7.2.2.2.9 Dose Conversion Factors

Dose Conversion Factors (DCF) from EPA Federal Guidance Report No. 11, Table 2.1 (Reference 15), and EPA Federal Guidance Report No. 12, Table III.1 (Reference 16), were used for the analysis. For selection of the inhalation DCF, the most limiting value for each radionuclide and each organ has been chosen.

7.2.2.2.10 Occupancy Time

An occupancy time of 2,080 hours is used for the analysis at the Controlled Area boundary considering the "real individual" guidance of ISG-13 (Reference 9). This assumes that the individual is exposed 40 hours per week for 52 weeks per year, which is conservative based on the actual land use at the Controlled Area boundary (see Section 2.1.4). An occupancy time of 8760 hours is used in the analysis at the nearest residence. This conservatively assumes that the individual is exposed 24 hours per day, 365 days per year.

7.2.2.2.11 Breathing Rate

A breathing rate of 3.3×10^{-4} m^3/sec for a worker was used for the analysis (Reference 5). This conservatively bounds the adult breathing rate (BR) of 2.5×10^{-4} m^3/sec for an individual.

7.2.2.3 Postulated Doses for Normal Conditions

The annual dose equivalent for the whole body, thyroid and other critical organs to an individual at the Controlled Area boundary and at the nearest residence were determined as a result of an assumed effluent release under normal conditions of storage (References 25 *and 26*). Postulated doses are calculated for inhalation and external submersion in the plume at each of the two locations from the TNP ISFSI. The doses were determined using spreadsheet software.

7.2.2.3.1 Whole Body Dose

The annual dose equivalent (ADE) to the whole body is the sum of the inhaled committed effective dose equivalent (CEDE) and the deep dose equivalent (DDE) to the whole body from submersion in the plume. The shallow dose equivalent (SDE) is the dose to the skin from submersion in the plume.

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

Inhalation: Volatiles/Fines/Gases/Crud Dose

$CDE_{i,j}$ or $CEDE_{i,}$ (mrem/yr) =

$$Q_i(\frac{Ci}{\sec}) \times \frac{\chi}{Q}(\frac{\sec}{m^3}) \times B_r(\frac{m^3}{\sec}) \times DCF(I)_{i,j}(\frac{mrem}{\mu Ci}) \times 1E6\,(\frac{\mu Ci}{Ci}) \times 7.49E6(\frac{\sec}{yr})$$

B_r	=	breathing rates (Reference Man) = 3.3×10^{-4} m^3/sec
χ/Q	=	dispersion factor (See Table 7.2-11)
$DCF(I)_{i,j}$	=	inhalation dose conversion factor for nuclide i, for organ j
$CDE_{i,j}$	=	committed dose equivalent for internal organ dose from nuclide i, for organ j
$CEDE_i$	=	committed effective dose equivalent from nuclide i

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

7. Area radiation monitoring instrumentation consists of thermoluminescent devices (TLDs) posted at the perimeter of and in the Controlled Area near the Concrete Casks.

8. No resin or sludge is produced from the MPC or Concrete Casks.

7.3.2 SHIELDING

The Trojan Storage System is designed to maintain radiation exposure As Low As Reasonably Achievable (ALARA). The Concrete Cask design results in an average external dose rate (gamma and neutron) of less than 100 mrem/hr on the sides and 350 mrem/hr on top and at the air inlets and outlets. This design satisfies the requirements of 10 CFR 72.104, 10 CFR 72.106, and OAR 345-026-0390, which establish dose limits for members of the public in unrestricted areas (i.e., at or beyond the *Trojan ISFSI* Controlled Area boundary, *which as discussed in Section 7.3.2.3 is established at* ~~of 300~~ *200* meters).

Besides the Concrete Cask, MPC, and the Transfer Cask, no other radiation shielding features are required for the TNP ISFSI. However, the ISFSI location has natural earth berms located on the North and East sides. The terrain in the other directions is not flat but there are no earth berms immediately surrounding the ISFSI. Conservatively, the analysis in this SAR does not take any shielding credit for earth berms or physical structures that exist between the ISFSI and the Controlled Area boundary. The terrain was assumed to be flat ground.

7.3.2.1 Radial and Axial Shielding Configurations

The radiation shielding for the stored spent nuclear fuel assemblies is provided by a variety of shielding materials in the MPC, Concrete Cask, and Transfer Cask. Figures 4.2-4 and 4.7-1 depict the Concrete Cask and the Transfer Cask. The shielding models were created in full three-dimensional detail and accurately represent the configurations shown in those figures (minor exceptions include the hole for the gap flush system and inflatable seal (used during cask loading operations) details for the Transfer Cask). The top lid on the Transfer Cask was conservatively not modeled. The densities for constituent elements of all shielding materials used in the calculational models are given in Table 7.3-1.

The MPC contains a 9.5-inch thick stainless steel lid and a 2.5-inch thick baseplate, both of which connect to the 0.5-inch thick MPC shell. The MPC lid provided radiation protection for workers during MPC loading operations, and provides the largest majority of the shielding in the top axial direction during storage. Additional shielding in the top axial direction of the Concrete Cask is provided by the 0.75- inch thick steel lid on the Concrete Cask. In addition, a steel shield ring, 6 inches tall and 4 inches thick with an inner diameter of 64 inches, immediately above the MPC/Concrete Cask inner liner annulus adds protection from radiation streaming up this annulus. Shielding located axially beneath the MPC consists of the steel MPC baseplate, the steel Concrete Cask liner bottom, and a thick section of concrete.

burnup and cooling time condition. The results presented in Tables 7.3-8 and 7.3-9 are for the south side of the ISFSI which produces the highest dose rate of the four ISFSI sides. The results of the Trojan ISFSI dose rate calculations are discussed further in Sections 7.4 and 7.6.

7.3.2.3 Controlled Area Boundary Dose Rate

As presented in Sections 7.3.2.1 and 7.3.2.2, the Trojan ISFSI shielding analysis was performed prior to loading the ISFSI storage casks to conservatively predict dose rates at various distances from a single cask and from the entire ISFSI. These results were then used to establish (in conjunction with predicted effluent release results as required by 10 CFR 72.104, 10 CFR 72.106, and OAR 345-026-0390) the Trojan ISFSI Controlled Area boundary at 300 meters from the edge of the Storage Pad, and to conservatively estimate occupational (working) doses and annual dose to an individual member of the public at both the Controlled Area boundary and at the nearest resident distance of 660 meters (Reference 24).

As detailed in Sections 7.3.2.1 and 7.3.2.2, the shielding analysis incorporated considerable conservatism, such that actual direct radiation dose rates following ISFSI loading were anticipated to be well below the predicted values. Following the completion of Trojan ISFSI loading, measurements of actual radiation dose emanating from the ISFSI confirmed this extreme conservatism in the calculated values, with actual dose rates measured to be approximately five (5) percent of predicted dose rates at equivalent distances/locations. In light of this confirmation it was recognized that the Trojan ISFSI Controlled Area was unnecessarily large, and thus a new Trojan ISFSI calculation (Reference 26) was performed based on the actual direct radiation measurements to reduce the size of the Controlled Area.

The new calculation (Reference 26) applies a scaling factor to the results of the Trojan ISFSI shielding analysis (Reference 24) to conservatively reflect actual measured radiation dose rates rather than dose rates calculated from computer simulations and computations as described in Sections 7.2.1, 7.3.2.1, and 7.3.2.2. The scaling factor is derived by taking direct measurements of the radiation dose rate from the Trojan ISFSI, adjusting each measured value to conservatively account for instrument accuracy and background radiation levels, and dividing each result by the dose rate value predicted at the equivalent distance and location by the Trojan ISFSI shielding analysis. Applying the scaling factor to the shielding analysis results summarized in Table 7.3-9 confirm that (even after including postulated normal, off-normal, and hypothetical accident condition effluent release dose consequences as discussed in Sections 7.6.2 and 7.6.3) establishment of the Trojan ISFSI Controlled Area boundary at a distance of 200 meters from the edge of the Storage Pad ensures that resultant doses at the boundary are well below the limits of 10 CFR 72.104, 10 CFR 72.106, and OAR 345-026-0390. Thus, the Trojan ISFSI Controlled Area boundary is established at 200 meters from the edge of the Storage Pad.

As indicated in Table 7.4-4, the annual total whole body dose equivalent at the 200-meter Controlled Area boundary due to direct radiation calculated based on actual radiation measurement is approximately 3.5 mrem/yr. It is noted that this calculated value is the bounding *design basis dose rate for the Trojan ISFSI 200-meter Controlled Area boundary, replacing that calculated in the shielding analysis for a distance of 200 meters as presented in Table 7.3-9. Notwithstanding, the design basis shielding analysis results presented in Sections 7.3.2.1 and 7.3.2.2 remain bounding for predicted occupational dose rates (see Section 7.4) and for annual dose to the nearest resident (660 meters; see Section 7.6).*

7.3.3 VENTILATION

The Concrete Cask is designed for passive, natural convection cooling of the MPC. The air flow path is formed by the channels at the bottom (air entrance), the air inlet ducts, the annulus between the MPC exterior and the Concrete Cask interior, and the air outlet ducts.

The air inlets and outlets are steel lined penetrations that take non-planar paths to minimize radiation streaming.

The Concrete Cask system is designed to prevent the release of radioactive material during normal storage conditions. However, the potential effects of postulated MPC leakage are evaluated in Chapter 8. Evaluations of partial and full blockage of the air inlets are also presented in Chapter 8.

There are no off-gas systems required for normal operation of the ISFSI because the MPC is sealed.

7.3.4 AREA RADIATION AND AIRBORNE RADIOACTIVITY MONITORING INSTRUMENTATION

During ISFSI storage operations, area radiation monitoring will consist of TLDs posted at the perimeter of and in the Controlled Area near the Concrete Casks. The TLDs will be used to monitor operation of the ISFSI for the Radioactive Effluent and Environmental Monitoring Program described in Section 7.6.

7.6 ESTIMATED OFF-SITE COLLECTIVE DOSE ASSESSMENT

7.6.1 RADIOACTIVE EFFLUENT AND ENVIRONMENTAL MONITORING PROGRAM

No radioactive gas, liquid, or solid waste effluents are expected during operation. Therefore, a radioactive effluent monitoring system is not required and routine monitoring for effluents is not performed.

The ISFSI emits direct radiation that is monitored in the environment. The Radioactive Effluent and Environmental Monitoring Program is implemented by posting TLDs at the perimeter of and in the Controlled Area near the Concrete Casks. TLDs are read quarterly to monitor radiation levels in the nearby vicinity of the ISFSI.

7.6.2 ANALYSIS OF MULTIPLE CONTRIBUTION

Once the Trojan Nuclear Plant is decommissioned, the only significant radiation will come from the Trojan ISFSI. No other nuclear facility is projected for the vicinity of the ISFSI (i.e., within a 5-mile radius).

The incremental contribution of the ISFSI to the total dose of a member of the general public has been estimated by calculation at two locations. Both direct radiation and effluent release from the ISFSI have been considered in this analysis. The first location is the Controlled Area boundary at a distance of ~~300~~ *200* meters and the second is at the nearest resident at a distance of approximately 660 meters. ~~Conservatively, the~~ *For the nearest resident analysis, the* confinement evaluation *conservatively uses an atmospheric dispersion factor for 600 meters* ~~was performed at shorter distances for both the Controlled Area boundary and the nearest resident, 200 and 600 meters respectively~~. An occupancy time of 2080 hours per year was used for the Controlled Area boundary and an occupancy time of 8760 hours per year (full occupancy) was used for the nearest resident. The 2080 hour per year occupancy factor is used, in accordance with Interim Staff Guidance Document 13 (Reference 9), to represent a conservative maximum estimate of a real individual's occupancy time at the Controlled Area boundary (40 hours per week for 52 weeks). The 2080 hour per year occupancy factor is conservative considering the land usage patterns in the vicinity of the ISFSI.

Based on the following analysis, it also has been determined that dose due to recreational usage of the Columbia River is bounded by the evaluation of doses at the Controlled Area boundary. The Trojan Nuclear Plant Final Safety Analysis Report (FSAR) incorporated an occupancy rate of 5 hours/year for shoreline/boating use of the Columbia River adjacent to the Trojan site by an individual member of the public. This factor was applied to the estimation of exposure to routine releases from the Trojan Nuclear Plant during reactor operation, and is believed to be equally conservative for estimation of dose to an individual user of the river due to Trojan ISFSI storage operations. However, for the purposes of this analysis, an occupancy rate of 24 hours/year is conservatively assumed. Moreover, it is conservatively assumed that the entire 24 hours of usage is at the river shoreline.[1] In addition, the shielding effect of the earthen berms located directly east and north of the ISFSI Storage Pad is conservatively neglected.

The closest distance from the ISFSI to the river shoreline east of the Storage Pad is approximately 53 meters. The elevation of the river shoreline is considerably below the surface of the Storage Pad, which is at approximately 46 feet MSL, so only dose emanating from the sides of the Trojan ISFSI is considered. This assumption is conservative since it ignores the shielding effects of the ground and rock for individuals that are close to the shoreline and thus are not within direct line of sight of the Concrete Casks. As indicated in Table 7.3-8 of the Trojan ISFSI SAR, even conservatively assuming that every cask contains fuel with the design basis bounding burnup and cooling time, an individual at this distance would be exposed to a dose rate less than 0.45 mrem/hour (see Table 7.3-8 entry for total side dose at 45.72 meters). Thus, even if the conservative occupancy rate of 24 hours/year is assumed for an individual recreational user of the river, the resultant direct dose to an individual on the river shoreline would be less than 11 mrem/year, well below the calculated doses at the Controlled Area boundary and well within the 25 mrem/yr regulatory limit. As seen in Table 7.4-2 and Table 8.2-2, the calculated normal and off-normal effluent doses are a relatively small portion of the total dose at the Controlled Area boundary and nearest resident, and similarly would be a relatively small portion of the dose at the river shoreline. It would thus be reasonably concluded that the total dose from normal and off-normal conditions to an individual recreational user of the Columbia River, especially when considering the extreme conservatism built into the above analysis, is bounded by the evaluation of doses at the Controlled Area boundary.

7.6.3 ESTIMATED DOSE EQUIVALENTS

The sum of the maximum doses from normal and off-normal releases and direct radiation are given in Table 7.4-4 *for both the Controlled Area boundary and the nearest resident.* A comparison to the regulatory limits is also provided in this table. The breakdown of the off-normal and accident dose rates by organ can be found in Table 8.2-2.

These results clearly indicate that the Trojan ISFSI is well within the regulatory requirements of 10 CFR 72.104. The effluent contribution listed in Table 7.4-4 is also well within the regulatory limits of OAR 345-026-0390(4)(f).

The results for direct radiation dose at the 200-meter Controlled Area boundary presented in Table 7.4-4 are based on actual radiation measurements as discussed in Section 7.3.2.3. The results for direct radiation *dose at the nearest resident (660 meters)* presented in Table 7.4-4 conservatively represent the condition of uniform burnup and cooling time in which all casks in the ISFSI are assumed to have TPDs and the same burnup and cooling time of 42,000 MWD/MTU and 9-year cooling. If credit was taken for the variable burnup and cooling

[1] It should be noted that based on experience and observation of river usage adjacent to the Trojan site, perhaps due to the steeply inclined terrain protruding to the river's edge, river users are not typically observed on the shoreline directly adjacent to the Trojan ISFSI Storage Pad.

time in the ISFSI as described in Table 7.3-5, the ~~18.4 mrem/year and~~ 2.19 mrem/year at the ~~Controlled Area boundary and~~ nearest resident would reduce to ~~10.2 mrem/year and~~ 1.25 mrem/year ~~, respectively~~.

7.6.4 LIQUID RELEASE

There are no radioactive liquids to be released from the Trojan ISFSI.

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

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

15. 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,*" *EPA-520/1-88-020*, 1988.

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

17. Rohsenow, W.M. and Hartnett, J.P., "*Handbook of Heat Transfer,*" McGraw Hill Book Company, New York, 1973.

18. U.S. Department of Energy, "Characteristics of Spent Fuel, High-Level Waste, and Other Radioactive Wastes Which May Require Long-Term Isolation," DOE/RW-0184, December 1987.

19. Ludwig, S. B. and Renier, J. P., "Standard- and Extended-Burnup PWR and BWR Reactor Models for the ORIGEN2 Computer Code," ORNL/TM-11018, ORNL, December 1989.

20. Luksic, A., "Spent Fuel Assembly Hardware: Characterization and 10 CFR 61 Classification for Waste Disposal," PNL-6906-Vol. 1, Pacific Northwest Laboratory, June 1989.

21. U.S. Department of Energy, "Characteristics of Potential Repository Wastes," DOE/RW-0184-R1, July 1992.

22. Cacciapouti, R. J., Van Volkinburg, S., "Axial Burnup Profile Database for the Combustion Engineering 14X14 Fuel Design," September 1995.

23. Holtec Report No. HI-2012662, "Fuel Parameter Evaluation of TNP Fuel to be Stored at the Trojan ISFSI," Revision 3.

24. Holtec Report No. HI-2012749, "Shielding Evaluation for the Trojan ISFSI Completion Project," Revision 2.

25. Holtec Report No. HI-2012677, "Trojan ISFSI Site Boundary Confinement Analysis," Revision 5.

26. *Trojan ISFSI (TI) Calculation No. TI-159, "Calculation to Establish Trojan ISFSI Controlled Area Boundary at 200 Meters."*

Table 7.2-11

Bounding χ/Q Values for the Controlled Area Boundary and Nearest Residence for Normal Conditions

Location	Distance for Developing χ/Q	χ/Q
Controlled Area Boundary (~~300~~ *200* meters)	200 meters	3.75E-05
Nearest Resident (approximately 660 meters)	600 meters	5.50E-06

Table 7.4-2

Normal Condition Effluent Dose Calculation Results for the Fully Loaded Trojan ISFSI

	Dose Results (mrem/yr)							
	Whole body	Thyroid	Red Bone Marrow	Lung	Bone Surface	Gonad	Breast	Skin
Controlled Area Boundary *(200 m)*	0.11	0.012	0.12	0.40	1.22	0.021	0.013	4.11E-04
Nearest Resident	0.070	0.007	0.071	0.25	0.75	0.013	0.008	2.55E-04

Table 7.4-4

Dose Rates at the Controlled Area Boundary and Nearest Resident from Effluent and Direct Radiation During Normal and Off-Normal Conditions

~~(Casks Assumed to Have Uniform Burnup~~
~~And Cooling Time Of 42,000 MWD/MTU And 9 Years Cooling)~~

Controlled Area Boundary at ~~300~~ *200* Meters
2080 Hours/Year
(Based on Actual Measured Dose Rate from Fully Loaded ISFSI)

	Dose Rate from Effluent Release (mrem/year)	**Direct Dose Rate (mrem/year)**	**Total Dose Rate (mrem/year)**	**Regulatory Limit (mrem/year)**
10CFR72.104(a) – Normal + Off-Normal				
Whole Body ADE	0.133	*3.5*~~18.4~~	*3.6*~~18.533~~	25
Thyroid ADE	0.012	*3.5*~~18.4~~	*3.5*~~18.4~~	75
Critical Organ ADE (Max)	1.58	*3.5*~~18.4~~	*5.1*~~19.98~~	25
ADE: Annual Dose Equivalent				

Nearest Resident At 660 Meters
8760 Hours/Year
(Casks Assumed to Have Uniform Burnup
And Cooling Time Of 42,000 MWD/MTU and 9 Years Cooling)

	Dose Rate from Effluent Release (mrem/year)	**Direct Dose Rate (mrem/year)**	**Total Dose Rate (mrem/year)**	**Regulatory Limit (mrem/year)**
10CFR72.104(a) – Normal + Off-Normal				
Whole Body ADE	0.084	2.19	2.27	25
Thyroid ADE	0.007	2.19	2.20	75
Critical Organ ADE (Max)	0.969	2.19	3.16	25
ADE: Annual Dose Equivalent				

The atmospheric dispersion factor (χ/Q) at 100 meters was calculated using the general methods for ground level releases described in Regulatory Guide 1.25. The χ/Q was calculated assuming:

- Wind speed of 1 meter/second;
- Uniform wind direction;
- F-stability diffusion;
- A two-hour release period consistent with a short duration release, and
- A distance of 100 meters from the ISFSI

Use of a 100-meter χ/Q is conservative for the Trojan ISFSI Controlled Area boundary, which is located at ~~300~~ *200* meters from the *edge of the* ISFSI *Storage Pad*, because at increased distance the χ/Q and, therefore, the resulting dose would be lower.

The total releasable surface contamination from a single MPC was calculated by multiplying the allowable surface contamination per unit area by the surface area of the top and side of the MPC. The physical dimensions of the Trojan MPC-24E/EF (181.3-inch height and 68 3/8-inch diameter) are necessary for calculation of the exposed surface area of a single MPC:

$$\text{MPC Surface Area} = \text{Side Surface Area of MPC} + \text{Top Surface Area of MPC}$$
$$= 2.749\text{x}10^5 \text{ cm}^2$$

The total radionuclide inventory available for release from the ISFSI for this event (R) is calculated using the following formula (conservatively assuming 36 casks on the Trojan ISFSI Pad):

$$R = \text{MPC Surface Area x Allowable Surface Contamination x No. of MPCs}$$
$$= 2.749\text{x}10^5 \text{ cm}^2 * 1.0\text{x}10^{-4} \ \mu\text{Ci/cm}^2 * 36$$
$$= 989.8 \ \mu\text{Ci}$$

The total effective dose equivalent (TEDE) is the sum of the committed effective dose equivalent (CEDE) and the deep dose equivalent (DDE) to the whole body. However, based on previous confinement analysis work, the DDE is negligible compared to the CEDE and is ignored. For the calculation of the CEDE, it is assumed that the entire radionuclide inventory available for release consists of a plume of ^{60}Co particulates transported instantaneously to the dose point location. The CEDE is calculated as follows:

$$\text{CEDE} = \text{R x DCF x } \chi/Q \text{ x BR}$$

This Design Basis event was considered in the establishment of the appropriate Controlled Area boundary pursuant to 10 CFR 72.106 and Oregon Administrative Rule OAR 345-026-0390(4)(c). *Especially with consideration that actual radiation dose rates from the ISFSI have been verified by direct measurement to be well below design calculated values (see Section 7.3.2.3),* ~~T~~*t*he direct radiation levels at the Controlled Area boundary, ~~300~~ *200* meters *from the edge of the Storage Pad*, as a result of this event are minimal for the expected duration of the event.

8.2.5 EARTHQUAKE EVENT

This event is a Seismic Margin Earthquake (SME)

8.2.5.1 Cause of Accident

An earthquake that affects the ISFSI initiates this event. The Seismic Margin Earthquake (SME) is described and discussed in Section 2.6.2.4.

8.2.5.2 Accident Analysis

The loaded Concrete Cask has been analyzed for the Seismic Margin Earthquake (SME). The SME, which has a peak horizontal ground acceleration of 0.38g and a peak vertical ground acceleration of 0.25g, has been used as the design basis earthquake for the Concrete Cask. The analysis of this event is summarized below. Use of the SME in accordance with Oregon Administrative Rule OAR 345-026-0390(4)(c) is also described in Section 2.6.2.4.

The Concrete Cask is a very stiff structure. Its lowest natural frequencies are well beyond the Zero Period Acceleration (ZPA) threshold of the site spectra. No dynamic amplification of the ground motion is expected from the Concrete Cask. Although free-standing, it has been analyzed as a cantilever fixed at the base (Roark and Young, "Formulas for Stress and Strain," 5th Edition, Table 36, Case 3b). For the purpose of calculating seismic loads, the Concrete Cask is treated as a rigid body attached to the ground. Equivalent static analysis methods were used to calculate loads, stresses, and overturning moments.

The fundamental natural frequency of vibration for the Concrete Cask was determined as shown below (Reference 1):

$$f_n = [(K_n)/2\pi]\,[(E)(I)(g)/(w)(L^4)]^{0.5} = 48.5 \text{ cycles per second}$$

where:

f_n = Frequency of the n^{th} mode

K_n = 3.52 for first mode of vibration

E = Modulus of Elasticity = $57{,}000\,(f_c)^{0.5} = 57{,}000\,(4{,}000 \text{ psi})^{0.5}$ = 3,604,996 psi

3. Bounding case hypothetical natural gas-air mixture confined explosions inside plant structures would not generate debris missiles capable of causing unacceptable damage to the ISFSI.

4. Extreme seismic event or tornado effects on the NGTCC plant would not result in damage to the ISFSI.

Based on the above, it has been concluded that the proposed NGTCC plant at the Trojan site would not adversely affect the ISFSI.

8.2.14.3 Accident Dose Calculations

With the exception of missiles generated by confined explosions, no event associated with the use of a NGTCC facility presents a significant potential to cause increased offsite or occupational doses. The Concrete Cask would be repaired following a missile impact by filling the damaged area with grout. It is presumed that some period of time will be required to obtain the materials needed to repair the Concrete Cask surface. Shielding materials will be maintained on site for use in mitigating the consequences of this event until such time as a repair to the Concrete Cask surface can be completed. It is estimated that shielding materials can be in place within 12 hours of the event. It is estimated that once the necessary materials are obtained two technicians would be able to complete the repair in approximately 30 minutes. The collective dose to the repair crew would be less than or equal to approximately 0.238 person-rem (119.0 mrem to each technician). *Especially with consideration that actual radiation dose rates from the ISFSI have been verified by direct measurement to be well below design calculated values (see Section 7.3.2.3),* ~~D~~*d*irect radiation levels at the *200-meter* Controlled Area boundary as a result of this event are minimal for the expected duration of the event.

Table 8.2-6

Bounding χ/Q Values for the Controlled Area Boundary and Nearest Residence for Accident Conditions

Location	Distance for Developing χ/Q	χ/Q
Controlled Area Boundary (~~300~~ *200* meters)	200 meters	3.25E-04
Nearest Resident (approximately 660 meters)	600 meters	4.80E-05

ENCLOSURE III
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Proposed Revision to the Trojan ISFSI Safety Analysis Report

Clean Copy (Changes Annotated by Margin Sidebars Only)

Four 230kV overhead transmission lines terminate in a switchyard approximately 1000 feet from the ISFSI. The switchyard supplies power to the ISFSI site.

The Controlled Area, as defined in 10 CFR 72.106, immediately surrounds the ISFSI and extends out to 200 meters from the edge of the Storage Pad (Figure 2.1-2). The Controlled Area lies entirely on PGE property with the exception of a portion of the Controlled Area that extends over the Columbia River. U.S. Highway 30 is not within the Controlled Area. PGE has formal agreements with the U.S. Coast Guard to restrict traffic on the Columbia River, and with the state of Oregon to enable PGE to evacuate persons from publicly owned lands (i.e., tidelands) in the event of an emergency at the ISFSI.

The doses that could be anticipated at the Controlled Area boundary from an off-normal event or accident are discussed in Chapter 8 and are below the limits of 10 CFR 72.106 and Oregon Administrative Rule (OAR) 345-026-0390.

2.1.2.1 Other Activities Within the ISFSI Site Boundary

No activities unrelated to ISFSI operation are performed within the ISFSI controlled access area boundary.

Several major physical facilities, which were used during Trojan Nuclear Plant operation, are grouped to the south and west of the ISFSI site. These facilities are outside the ISFSI controlled access area and are intended to be made available for commercial activities upon their release for unrestricted use. Leases issued to commercial users of these facilities will limit activities to ensure that postulated events and accident analyses remain bounding. Access to these facilities will not afford access to the ISFSI.

2.1.2.2 Boundaries for Establishing Effluent Release Limits

The only potential effluent release points are the Concrete Casks themselves located at the ISFSI. The analyses presented in the HI-STORM FSAR (Reference 14) demonstrate that the MPC remains intact during all postulated off-normal and accident conditions. In summary, there is no mechanistic failure that results in a breach of the confinement boundary. However, the dose resulting from an effluent release due to a non-mechanistic ground-level breach of the confinement boundary during normal operation and anticipated occurrences (i.e., direct radiation) has been estimated at the Controlled Area boundary and is within the limits specified in 10 CFR 72.104 and OAR 345-026-0390.

The Restricted Area, as defined in 10 CFR 20, has the same boundaries as the controlled access area that surrounds the ISFSI Protected Area. Physical access to the Restricted Area is restricted by the controlled access area fence. Access into the Protected Area is controlled as described in

Meteorological data were collected during nuclear plant operation and for a time during defueled operation, but data will not be collected during ISFSI operation. The source terms for ISFSI operation are much lower than the source terms for nuclear plant operation. Accidents and off-normal events do not result in releases that would exceed 10 CFR 72.106 limits and OAR 345-026-0390. As a result, meteorological monitoring for the calculation of off-site doses from normal operation and accident conditions is not necessary. These doses can be effectively calculated by using conservative values for atmospheric dispersion (χ/Q) from the onsite historical data.

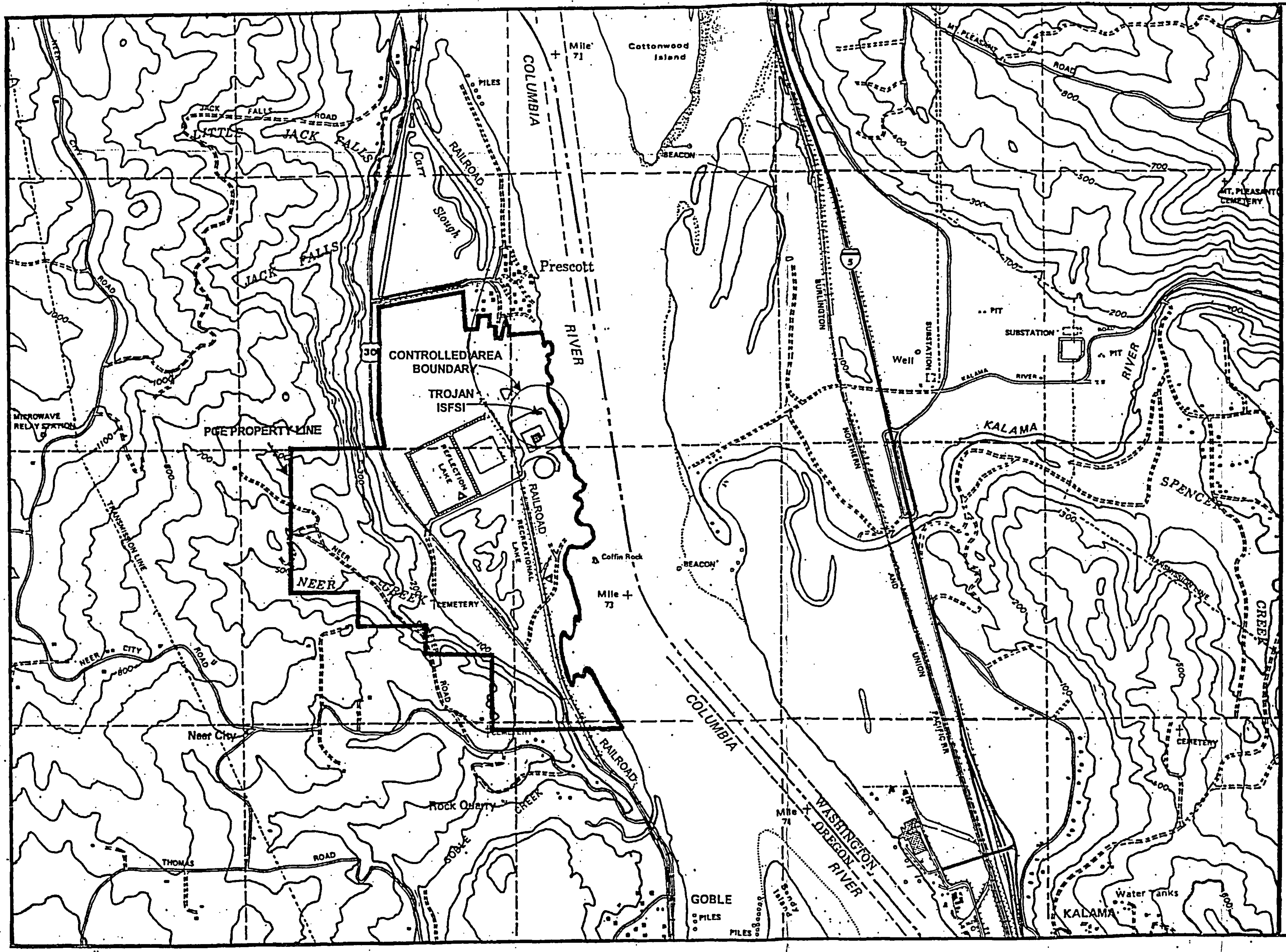
As stated above, meteorological data for the site during the period September 1, 1971 through August 31, 1974 compared favorably with National Weather Service data for Portland, Oregon. Hence, if real time meteorological data is desired, then data from the National Weather Service for Portland could be used.

2.3.4 DIFFUSION ESTIMATES

Worst case postulated long-term (routine) releases associated with operation of the ISFSI were modeled using a 50% probability diffusion value. The long-term diffusion estimate using 3- to 30-day average conditions is 3.75E-05 sec/m^3 at 200 meters. Determination of the long-term diffusion value at 200 meters is appropriate since the Trojan ISFSI Controlled Area Boundary is at 200 meters.

A hypothetical accident was also postulated to determine the concentrations and doses that could occur following the release. The 30-day accident diffusion estimate is obtained from the Trojan Nuclear Plant Safety Analysis Report. The hypothetical accident χ/Q at 200 meters is 3.25E-04 sec/m^3.

The atmospheric diffusion factor for the off-normal release of external contamination is calculated as described in Section 8.1.3.1.3 assuming a two-hour release period consistent with a short-duration release. The short-duration diffusion estimate at 100 meters is 3.5E-02 sec/m^3. Determination of the short-duration diffusion value at 100 meters is conservative since the Trojan ISFSI Controlled Area Boundary is at 200 meters.



TROJAN ISFSI
SAFETY ANALYSIS REPORT

FIGURE 2.1-2
PGE PROPERTY, ISFSI SITE, AND CONTROLLED AREA BOUNDARY
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design results in an average external side surface dose (gamma and neutron) of less than 100 mrem/hr on the sides and 300 mrem/hr on the top and at the air vents.

Expected dose rates associated with ISFSI operations are contained in Section 7.4.

3.3.5.3 Radiological Alarm Systems

The Concrete Cask system does not produce routine solid, liquid, or gaseous effluents. Section 8.1.3 discusses an inadvertent release of surface contamination from the exterior of the MPC. The consequences of this event are negligible (2.50 mrem at 100 meters). Therefore, an alarm for airborne radioactivity is not required to protect personnel or the environment.

As discussed in Chapter 7, the estimated working dose rate for the Concrete Cask (maximum fuel burnup) is 9.9 mrem/hr, and the highest dose rate at 100 meters from the edge of the ISFSI Storage Pad is calculated (based on the entire ISFSI uniformly loaded with design basis fuel assemblies) to be 0.18 mrem/hr. These dose rates do not warrant a radiation alarm to protect personnel or the environment.

Based on the above, radiological alarms are not required for the Trojan ISFSI.

3.3.6 FIRE AND EXPLOSION PROTECTION

The potential for fires at the ISFSI are minimized by the use of paved open areas and minimum combustible materials within the ISFSI security fence. As discussed in Section 2.2.3.3 the facility is well protected from industrial and forest fires by natural barriers. Sections 8.2.9 and 8.2.14.2.2 provide additional discussion on fires.

Explosion analyses for the ISFSI are presented in Sections 8.2.8, 8.2.14.2.3 and 8.2.14.2.4.

3.3.7 MATERIALS HANDLING AND STORAGE

3.3.7.1 Spent Fuel Handling and Storage

The loading of each MPC is limited to the design basis maximum decay heat load limit shown in Table 3.1-3 (Reference 8). The Trojan Storage System is designed to accommodate the design basis maximum decay heat load and maintain fuel cladding temperature below limits established for inert dry storage (Reference 4). In addition, temperature limits for storage system components are also maintained below design limits. The Technical Specifications establish surveillances to preclude exceeding material design temperature limits.

The fuel clad temperature limit is a function of fuel burnup, fuel pin fill gas pressure, and fuel age. For the Trojan ISFSI, the fuel clad temperature limit is shown in Table 3.1-3. This limit was determined using Westinghouse 17x17 fuel with a limiting combination of cooling time and burnup to produce the highest decay heat emission rate, as shown in Table 3.1-3. This fuel is

7.2.2.2.7 Radionuclide Release Rate

The radionuclide release rate is the product of the quantity of isotopes available for release to the MPC cavity, the fraction of volume released per unit time, and the release fraction.

Volatiles/Fines/Gases/Crud

$$\text{Release Rate } (Q_i) = \frac{A_i(\text{Ci}) \times f_b \times [f_v \text{ or } f_f \text{ or } f_c \text{ or } f_g] \times L_{ts}\left(\frac{\text{cm}^3}{\text{sec}}\right)}{V_b(\text{cm}^3)}$$

where:

A_i	=	MPC activity of nuclide i (see Table 7.2-1)
L_{ts}	=	MPC leak rate under normal conditions = 7.37×10^{-6} (cm³/sec)
V_b	=	MPC internal free volume = 5.96×10^{6} (cm³)
L_{ts}/V_b	=	the fraction of volume released per second
f_b, f_v, f_f, f_c, f_g	=	See Table 7.2-12 for definitions

7.2.2.2.8 Atmospheric Dispersion Factor

For the evaluation for normal conditions of storage of the annual dose due to an effluent release at the Controlled Area boundary and the nearest resident, the χ/Q atmospheric dispersion factors are provided in Table 7.2-11. The χ/Q value for 200 meters was used for the dose calculation at the 200-meter Controlled Area boundary. The χ/Q value for 600 meters was used for the dose calculation at the location of the nearest resident.

7.2.2.2.9 Dose Conversion Factors

Dose Conversion Factors (DCF) from EPA Federal Guidance Report No. 11, Table 2.1 (Reference 15), and EPA Federal Guidance Report No. 12, Table III.1 (Reference 16), were used for the analysis. For selection of the inhalation DCF, the most limiting value for each radionuclide and each organ has been chosen.

7.2.2.2.10 Occupancy Time

An occupancy time of 2,080 hours is used for the analysis at the Controlled Area boundary considering the "real individual" guidance of ISG-13 (Reference 9). This assumes that the individual is exposed 40 hours per week for 52 weeks per year, which is conservative based on the actual land use at the Controlled Area boundary (see Section 2.1.4). An occupancy time of 8760 hours is used in the analysis at the nearest residence. This conservatively assumes that the individual is exposed 24 hours per day, 365 days per year.

7.2.2.2.11 Breathing Rate

A breathing rate of 3.3×10^{-4} m^3/sec for a worker was used for the analysis (Reference 5). This conservatively bounds the adult breathing rate (BR) of 2.5×10^{-4} m^3/sec for an individual.

7.2.2.3 Postulated Doses for Normal Conditions

The annual dose equivalent for the whole body, thyroid and other critical organs to an individual at the Controlled Area boundary and at the nearest residence were determined as a result of an assumed effluent release under normal conditions of storage (References 25 and 26). Postulated doses are calculated for inhalation and external submersion in the plume at each of the two locations from the TNP ISFSI. The doses were determined using spreadsheet software.

7.2.2.3.1 Whole Body Dose

The annual dose equivalent (ADE) to the whole body is the sum of the inhaled committed effective dose equivalent (CEDE) and the deep dose equivalent (DDE) to the whole body from submersion in the plume. The shallow dose equivalent (SDE) is the dose to the skin from submersion in the plume.

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

Inhalation: Volatiles/Fines/Gases/Crud Dose

$CDE_{i,j}$ or $CEDE_i$, (mrem/yr) =

$$Q_i\left(\frac{Ci}{\sec}\right) x \frac{\chi}{Q}\left(\frac{\sec}{m^3}\right) x\, B_r\left(\frac{m^3}{\sec}\right) x\, DCF(I)_{i,j}\left(\frac{mrem}{\mu Ci}\right) x\, 1E6\left(\frac{\mu Ci}{Ci}\right) x\, 7.49E6\left(\frac{\sec}{yr}\right)$$

B_r	=	breathing rates (Reference Man) = 3.3×10^{-4} m^3/sec
χ/Q	=	dispersion factor (See Table 7.2-11)
$DCF(I)_{i,j}$	=	inhalation dose conversion factor for nuclide i, for organ j
$CDE_{i,j}$	=	committed dose equivalent for internal organ dose from nuclide i, for organ j
$CEDE_i$	=	committed effective dose equivalent from nuclide i

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

7. Area radiation monitoring instrumentation consists of thermoluminescent devices (TLDs) posted at the perimeter of and in the Controlled Area near the Concrete Casks.

8. No resin or sludge is produced from the MPC or Concrete Casks.

7.3.2 SHIELDING

The Trojan Storage System is designed to maintain radiation exposure As Low As Reasonably Achievable (ALARA). The Concrete Cask design results in an average external dose rate (gamma and neutron) of less than 100 mrem/hr on the sides and 350 mrem/hr on top and at the air inlets and outlets. This design satisfies the requirements of 10 CFR 72.104, 10 CFR 72.106, and OAR 345-026-0390, which establish dose limits for members of the public in unrestricted areas (i.e., at or beyond the Trojan ISFSI Controlled Area boundary, which as discussed in Section 7.3.2.3 is established at 200 meters).

Besides the Concrete Cask, MPC, and the Transfer Cask, no other radiation shielding features are required for the TNP ISFSI. However, the ISFSI location has natural earth berms located on the North and East sides. The terrain in the other directions is not flat but there are no earth berms immediately surrounding the ISFSI. Conservatively, the analysis in this SAR does not take any shielding credit for earth berms or physical structures that exist between the ISFSI and the Controlled Area boundary. The terrain was assumed to be flat ground.

7.3.2.1 Radial and Axial Shielding Configurations

The radiation shielding for the stored spent nuclear fuel assemblies is provided by a variety of shielding materials in the MPC, Concrete Cask, and Transfer Cask. Figures 4.2-4 and 4.7-1 depict the Concrete Cask and the Transfer Cask. The shielding models were created in full three-dimensional detail and accurately represent the configurations shown in those figures (minor exceptions include the hole for the gap flush system and inflatable seal (used during cask loading operations) details for the Transfer Cask). The top lid on the Transfer Cask was conservatively not modeled. The densities for constituent elements of all shielding materials used in the calculational models are given in Table 7.3-1.

The MPC contains a 9.5-inch thick stainless steel lid and a 2.5-inch thick baseplate, both of which connect to the 0.5-inch thick MPC shell. The MPC lid provided radiation protection for workers during MPC loading operations, and provides the largest majority of the shielding in the top axial direction during storage. Additional shielding in the top axial direction of the Concrete Cask is provided by the 0.75- inch thick steel lid on the Concrete Cask. In addition, a steel shield ring, 6 inches tall and 4 inches thick with an inner diameter of 64 inches, immediately above the MPC/Concrete Cask inner liner annulus adds protection from radiation streaming up this annulus. Shielding located axially beneath the MPC consists of the steel MPC baseplate, the steel Concrete Cask liner bottom, and a thick section of concrete.

burnup and cooling time condition. The results presented in Tables 7.3-8 and 7.3-9 are for the south side of the ISFSI which produces the highest dose rate of the four ISFSI sides. The results of the Trojan ISFSI dose rate calculations are discussed further in Sections 7.4 and 7.6.

7.3.2.3 Controlled Area Boundary Dose Rate

As presented in Sections 7.3.2.1 and 7.3.2.2, the Trojan ISFSI shielding analysis was performed prior to loading the ISFSI storage casks to conservatively predict dose rates at various distances from a single cask and from the entire ISFSI. These results were then used to establish (in conjunction with predicted effluent release results as required by 10 CFR 72.104, 10 CFR 72.106, and OAR 345-026-0390) the Trojan ISFSI Controlled Area boundary at 300 meters from the edge of the Storage Pad, and to conservatively estimate occupational (working) doses and annual dose to an individual member of the public at both the Controlled Area boundary and at the nearest resident distance of 660 meters (Reference 24).

As detailed in Sections 7.3.2.1 and 7.3.2.2, the shielding analysis incorporated considerable conservatism, such that actual direct radiation dose rates following ISFSI loading were anticipated to be well below the predicted values. Following the completion of Trojan ISFSI loading, measurements of actual radiation dose emanating from the ISFSI confirmed this extreme conservatism in the calculated values, with actual dose rates measured to be approximately five (5) percent of predicted dose rates at equivalent distances/locations. In light of this confirmation it was recognized that the Trojan ISFSI Controlled Area was unnecessarily large, and thus a new Trojan ISFSI calculation (Reference 26) was performed based on the actual direct radiation measurements to reduce the size of the Controlled Area.

The new calculation (Reference 26) applies a scaling factor to the results of the Trojan ISFSI shielding analysis (Reference 24) to conservatively reflect actual measured radiation dose rates rather than dose rates calculated from computer simulations and computations as described in Sections 7.2.1, 7.3.2.1, and 7.3.2.2. The scaling factor is derived by taking direct measurements of the radiation dose rate from the Trojan ISFSI, adjusting each measured value to conservatively account for instrument accuracy and background radiation levels, and dividing each result by the dose rate value predicted at the equivalent distance and location by the Trojan ISFSI shielding analysis. Applying the scaling factor to the shielding analysis results summarized in Table 7.3-9 confirm that (even after including postulated normal, off-normal, and hypothetical accident condition effluent release dose consequences as discussed in Sections 7.6.2 and 7.6.3) establishment of the Trojan ISFSI Controlled Area boundary at a distance of 200 meters from the edge of the Storage Pad ensures that resultant doses at the boundary are well below the limits of 10 CFR 72.104, 10 CFR 72.106, and OAR 345-026-0390. Thus, the Trojan ISFSI Controlled Area boundary is established at 200 meters from the edge of the Storage Pad.

As indicated in Table 7.4-4, the annual total whole body dose equivalent at the 200-meter Controlled Area boundary due to direct radiation calculated based on actual radiation measurement is approximately 3.5 mrem/yr. It is noted that this calculated value is the bounding design basis dose rate for the Trojan ISFSI 200-meter Controlled Area boundary, replacing that calculated in the shielding analysis for a distance of 200 meters as presented in Table 7.3-9. Notwithstanding, the design basis shielding analysis results presented in Sections 7.3.2.1 and 7.3.2.2 remain bounding for predicted occupational dose rates (see Section 7.4) and for annual dose to the nearest resident (660 meters; see Section 7.6).

7.3.3 VENTILATION

The Concrete Cask is designed for passive, natural convection cooling of the MPC. The air flow path is formed by the channels at the bottom (air entrance), the air inlet ducts, the annulus between the MPC exterior and the Concrete Cask interior, and the air outlet ducts.

The air inlets and outlets are steel lined penetrations that take non-planar paths to minimize radiation streaming.

The Concrete Cask system is designed to prevent the release of radioactive material during normal storage conditions. However, the potential effects of postulated MPC leakage are evaluated in Chapter 8. Evaluations of partial and full blockage of the air inlets are also presented in Chapter 8.

There are no off-gas systems required for normal operation of the ISFSI because the MPC is sealed.

7.3.4 AREA RADIATION AND AIRBORNE RADIOACTIVITY MONITORING INSTRUMENTATION

During ISFSI storage operations, area radiation monitoring will consist of TLDs posted at the perimeter of and in the Controlled Area near the Concrete Casks. The TLDs will be used to monitor operation of the ISFSI for the Radioactive Effluent and Environmental Monitoring Program described in Section 7.6.

7.6 ESTIMATED OFF-SITE COLLECTIVE DOSE ASSESSMENT

7.6.1 RADIOACTIVE EFFLUENT AND ENVIRONMENTAL MONITORING PROGRAM

No radioactive gas, liquid, or solid waste effluents are expected during operation. Therefore, a radioactive effluent monitoring system is not required and routine monitoring for effluents is not performed.

The ISFSI emits direct radiation that is monitored in the environment. The Radioactive Effluent and Environmental Monitoring Program is implemented by posting TLDs at the perimeter of and in the Controlled Area near the Concrete Casks. TLDs are read quarterly to monitor radiation levels in the nearby vicinity of the ISFSI.

7.6.2 ANALYSIS OF MULTIPLE CONTRIBUTION

Once the Trojan Nuclear Plant is decommissioned, the only significant radiation will come from the Trojan ISFSI. No other nuclear facility is projected for the vicinity of the ISFSI (i.e., within a 5-mile radius).

The incremental contribution of the ISFSI to the total dose of a member of the general public has been estimated by calculation at two locations. Both direct radiation and effluent release from the ISFSI have been considered in this analysis. The first location is the Controlled Area boundary at a distance of 200 meters and the second is at the nearest resident at a distance of approximately 660 meters. For the nearest resident analysis, the confinement evaluation conservatively uses an atmospheric dispersion factor for 600 meters. An occupancy time of 2080 hours per year was used for the Controlled Area boundary and an occupancy time of 8760 hours per year (full occupancy) was used for the nearest resident. The 2080 hour per year occupancy factor is used, in accordance with Interim Staff Guidance Document 13 (Reference 9), to represent a conservative maximum estimate of a real individual's occupancy time at the Controlled Area boundary (40 hours per week for 52 weeks). The 2080 hour per year occupancy factor is conservative considering the land usage patterns in the vicinity of the ISFSI.

Based on the following analysis, it also has been determined that dose due to recreational usage of the Columbia River is bounded by the evaluation of doses at the Controlled Area boundary. The Trojan Nuclear Plant Final Safety Analysis Report (FSAR) incorporated an occupancy rate of 5 hours/year for shoreline/boating use of the Columbia River adjacent to the Trojan site by an individual member of the public. This factor was applied to the estimation of exposure to routine releases from the Trojan Nuclear Plant during reactor operation, and is believed to be equally conservative for estimation of dose to an individual user of the river due to Trojan ISFSI storage operations. However, for the purposes of this analysis, an occupancy rate of 24 hours/year is conservatively assumed. Moreover, it is conservatively assumed that the entire 24 hours of usage is at the river shoreline.[1] In addition, the shielding effect of the earthen berms located directly east and north of the ISFSI Storage Pad is conservatively neglected.

The closest distance from the ISFSI to the river shoreline east of the Storage Pad is approximately 53 meters. The elevation of the river shoreline is considerably below the surface of the Storage Pad, which is at approximately 46 feet MSL, so only dose emanating from the sides of the Trojan ISFSI is considered. This assumption is conservative since it ignores the shielding effects of the ground and rock for individuals that are close to the shoreline and thus are not within direct line of sight of the Concrete Casks. As indicated in Table 7.3-8 of the Trojan ISFSI SAR, even conservatively assuming that every cask contains fuel with the design basis bounding burnup and cooling time, an individual at this distance would be exposed to a dose rate less than 0.45 mrem/hour (see Table 7.3-8 entry for total side dose at 45.72 meters). Thus, even if the conservative occupancy rate of 24 hours/year is assumed for an individual recreational user of the river, the resultant direct dose to an individual on the river shoreline would be less than 11 mrem/year, well below the calculated doses at the Controlled Area boundary and well within the 25 mrem/yr regulatory limit. As seen in Table 7.4-2 and Table 8.2-2, the calculated normal and off-normal effluent doses are a relatively small portion of the total dose at the Controlled Area boundary and nearest resident, and similarly would be a relatively small portion of the dose at the river shoreline. It would thus be reasonably concluded that the total dose from normal and off-normal conditions to an individual recreational user of the Columbia River, especially when considering the extreme conservatism built into the above analysis, is bounded by the evaluation of doses at the Controlled Area boundary.

7.6.3 ESTIMATED DOSE EQUIVALENTS

The sum of the maximum doses from normal and off-normal releases and direct radiation are given in Table 7.4-4 for both the Controlled Area boundary and the nearest resident. A comparison to the regulatory limits is also provided in this table. The breakdown of the off-normal and accident dose rates by organ can be found in Table 8.2-2.

These results clearly indicate that the Trojan ISFSI is well within the regulatory requirements of 10 CFR 72.104. The effluent contribution listed in Table 7.4-4 is also well within the regulatory limits of OAR 345-026-0390(4)(f).

The results for direct radiation dose at the 200-meter Controlled Area boundary presented in Table 7.4-4 are based on actual radiation measurements as discussed in Section 7.3.2.3. The results for direct radiation dose at the nearest resident (660 meters) presented in Table 7.4-4 conservatively represent the condition of uniform burnup and cooling time in which all casks in the ISFSI are assumed to have TPDs and the same burnup and cooling time of 42,000 MWD/MTU and 9-year cooling. If credit was taken for the variable burnup and cooling

[1] It should be noted that based on experience and observation of river usage adjacent to the Trojan site, perhaps due to the steeply inclined terrain protruding to the river's edge, river users are not typically observed on the shoreline directly adjacent to the Trojan ISFSI Storage Pad.

time in the ISFSI as described in Table 7.3-5, the 2.19 mrem/year at the nearest resident would reduce to 1.25 mrem/year .

7.6.4 LIQUID RELEASE

There are no radioactive liquids to be released from the Trojan ISFSI.

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

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

15. 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,*" *EPA-520/1-88-020*, 1988.

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

17. Rohsenow, W.M. and Hartnett, J.P., "*Handbook of Heat Transfer*," McGraw Hill Book Company, New York, 1973.

18. U.S. Department of Energy, "Characteristics of Spent Fuel, High-Level Waste, and Other Radioactive Wastes Which May Require Long-Term Isolation," DOE/RW-0184, December 1987.

19. Ludwig, S. B. and Renier, J. P., "Standard- and Extended-Burnup PWR and BWR Reactor Models for the ORIGEN2 Computer Code," ORNL/TM-11018, ORNL, December 1989.

20. Luksic, A., "Spent Fuel Assembly Hardware: Characterization and 10 CFR 61 Classification for Waste Disposal," PNL-6906-Vol. 1, Pacific Northwest Laboratory, June 1989.

21. U.S. Department of Energy, "Characteristics of Potential Repository Wastes," DOE/RW-0184-R1, July 1992.

22. Cacciapouti, R. J., Van Volkinburg, S., "Axial Burnup Profile Database for the Combustion Engineering 14X14 Fuel Design," September 1995.

23. Holtec Report No. HI-2012662, "Fuel Parameter Evaluation of TNP Fuel to be Stored at the Trojan ISFSI," Revision 3.

24. Holtec Report No. HI-2012749, "Shielding Evaluation for the Trojan ISFSI Completion Project," Revision 2.

25. Holtec Report No. HI-2012677, "Trojan ISFSI Site Boundary Confinement Analysis," Revision 5.

26. Trojan ISFSI (TI) Calculation No. TI-159, "Calculation to Establish Trojan ISFSI Controlled Area Boundary at 200 Meters."

Table 7.2-11

Bounding χ/Q Values for the Controlled Area Boundary and Nearest Residence for Normal Conditions

Location	Distance for Developing χ/Q	χ/Q
Controlled Area Boundary (200 meters)	200 meters	3.75E-05
Nearest Resident (approximately 660 meters)	600 meters	5.50E-06

Table 7.4-2

Normal Condition Effluent Dose Calculation Results for the Fully Loaded Trojan ISFSI

	Dose Results (mrem/yr)							
	Whole body	Thyroid	Red Bone Marrow	Lung	Bone Surface	Gonad	Breast	Skin
Controlled Area Boundary (200 m)	0.11	0.012	0.12	0.40	1.22	0.021	0.013	4.11E-04
Nearest Resident	0.070	0.007	0.071	0.25	0.75	0.013	0.008	2.55E-04

Table 7.4-4

Dose Rates at the Controlled Area Boundary and Nearest Resident from Effluent and Direct Radiation During Normal and Off-Normal Conditions

Controlled Area Boundary at 200 Meters
2080 Hours/Year
(Based on Actual Measured Dose Rate from Fully Loaded ISFSI)

	Dose Rate from Effluent Release (mrem/year)	**Direct Dose Rate (mrem/year)**	**Total Dose Rate (mrem/year)**	**Regulatory Limit (mrem/year)**
10CFR72.104(a) – Normal + Off-Normal				
Whole Body ADE	0.133	3.5	3.6	25
Thyroid ADE	0.012	3.5	3.5	75
Critical Organ ADE (Max)	1.58	3.5	5.1	25
ADE: Annual Dose Equivalent				

Nearest Resident At 660 Meters
8760 Hours/Year
(Casks Assumed to Have Uniform Burnup
And Cooling Time Of 42,000 MWD/MTU and 9 Years Cooling)

	Dose Rate from Effluent Release (mrem/year)	**Direct Dose Rate (mrem/year)**	**Total Dose Rate (mrem/year)**	**Regulatory Limit (mrem/year)**
10CFR72.104(a) – Normal + Off-Normal				
Whole Body ADE	0.084	2.19	2.27	25
Thyroid ADE	0.007	2.19	2.20	75
Critical Organ ADE (Max)	0.969	2.19	3.16	25
ADE: Annual Dose Equivalent				

The atmospheric dispersion factor (χ/Q) at 100 meters was calculated using the general methods for ground level releases described in Regulatory Guide 1.25. The χ/Q was calculated assuming:

- Wind speed of 1 meter/second;
- Uniform wind direction;
- F-stability diffusion;
- A two-hour release period consistent with a short duration release, and
- A distance of 100 meters from the ISFSI

Use of a 100-meter χ/Q is conservative for the Trojan ISFSI Controlled Area boundary, which is located at 200 meters from the edge of the ISFSI Storage Pad, because at increased distance the χ/Q and, therefore, the resulting dose would be lower.

The total releasable surface contamination from a single MPC was calculated by multiplying the allowable surface contamination per unit area by the surface area of the top and side of the MPC. The physical dimensions of the Trojan MPC-24E/EF (181.3-inch height and 68 3/8-inch diameter) are necessary for calculation of the exposed surface area of a single MPC:

$$\begin{aligned} \text{MPC Surface Area} &= \text{Side Surface Area of MPC} + \text{Top Surface Area of MPC} \\ &= 2.749\text{x}10^5 \text{ cm}^2 \end{aligned}$$

The total radionuclide inventory available for release from the ISFSI for this event (R) is calculated using the following formula (conservatively assuming 36 casks on the Trojan ISFSI Pad):

$$\begin{aligned} R &= \text{MPC Surface Area x Allowable Surface Contamination x No. of MPCs} \\ &= 2.749\text{x}10^5 \text{ cm}^2 * 1.0\text{x}10^{-4}\ \mu\text{Ci/cm}^2 * 36 \\ &= 989.8\ \mu\text{Ci} \end{aligned}$$

The total effective dose equivalent (TEDE) is the sum of the committed effective dose equivalent (CEDE) and the deep dose equivalent (DDE) to the whole body. However, based on previous confinement analysis work, the DDE is negligible compared to the CEDE and is ignored. For the calculation of the CEDE, it is assumed that the entire radionuclide inventory available for release consists of a plume of ^{60}Co particulates transported instantaneously to the dose point location. The CEDE is calculated as follows:

$$\text{CEDE} = \text{R x DCF x } \chi/Q \text{ x BR}$$

This Design Basis event was considered in the establishment of the appropriate Controlled Area boundary pursuant to 10 CFR 72.106 and Oregon Administrative Rule OAR 345-026-0390(4)(c). Especially with consideration that actual radiation dose rates from the ISFSI have been verified by direct measurement to be well below design calculated values (see Section 7.3.2.3), the direct radiation levels at the Controlled Area boundary, 200 meters from the edge of the Storage Pad, as a result of this event are minimal for the expected duration of the event.

8.2.5 EARTHQUAKE EVENT

This event is a Seismic Margin Earthquake (SME)

8.2.5.1 Cause of Accident

An earthquake that affects the ISFSI initiates this event. The Seismic Margin Earthquake (SME) is described and discussed in Section 2.6.2.4.

8.2.5.2 Accident Analysis

The loaded Concrete Cask has been analyzed for the Seismic Margin Earthquake (SME). The SME, which has a peak horizontal ground acceleration of 0.38g and a peak vertical ground acceleration of 0.25g, has been used as the design basis earthquake for the Concrete Cask. The analysis of this event is summarized below. Use of the SME in accordance with Oregon Administrative Rule OAR 345-026-0390(4)(c) is also described in Section 2.6.2.4.

The Concrete Cask is a very stiff structure. Its lowest natural frequencies are well beyond the Zero Period Acceleration (ZPA) threshold of the site spectra. No dynamic amplification of the ground motion is expected from the Concrete Cask. Although free-standing, it has been analyzed as a cantilever fixed at the base (Roark and Young, "Formulas for Stress and Strain," 5th Edition, Table 36, Case 3b). For the purpose of calculating seismic loads, the Concrete Cask is treated as a rigid body attached to the ground. Equivalent static analysis methods were used to calculate loads, stresses, and overturning moments.

The fundamental natural frequency of vibration for the Concrete Cask was determined as shown below (Reference 1):

$$f_n = [(K_n)/2\pi]\,[(E)(I)(g)/(w)(L^4)]^{0.5} = 48.5 \text{ cycles per second}$$

where:

f_n = Frequency of the n^{th} mode

K_n = 3.52 for first mode of vibration

E = Modulus of Elasticity = $57,000\,(f_c)^{0.5} = 57,000\,(4,000 \text{ psi})^{0.5}$ = 3,604,996 psi

3. Bounding case hypothetical natural gas-air mixture confined explosions inside plant structures would not generate debris missiles capable of causing unacceptable damage to the ISFSI.

4. Extreme seismic event or tornado effects on the NGTCC plant would not result in damage to the ISFSI.

Based on the above, it has been concluded that the proposed NGTCC plant at the Trojan site would not adversely affect the ISFSI.

8.2.14.3 Accident Dose Calculations

With the exception of missiles generated by confined explosions, no event associated with the use of a NGTCC facility presents a significant potential to cause increased offsite or occupational doses. The Concrete Cask would be repaired following a missile impact by filling the damaged area with grout. It is presumed that some period of time will be required to obtain the materials needed to repair the Concrete Cask surface. Shielding materials will be maintained on site for use in mitigating the consequences of this event until such time as a repair to the Concrete Cask surface can be completed. It is estimated that shielding materials can be in place within 12 hours of the event. It is estimated that once the necessary materials are obtained two technicians would be able to complete the repair in approximately 30 minutes. The collective dose to the repair crew would be less than or equal to approximately 0.238 person-rem (119.0 mrem to each technician). Especially with consideration that actual radiation dose rates from the ISFSI have been verified by direct measurement to be well below design calculated values (see Section 7.3.2.3), direct radiation levels at the 200-meter Controlled Area boundary as a result of this event are minimal for the expected duration of the event.

Table 8.2-6

Bounding χ/Q Values for the Controlled Area Boundary and Nearest Residence for Accident Conditions

Location	Distance for Developing χ/Q	χ/Q
Controlled Area Boundary (200 meters)	200 meters	3.25E-04
Nearest Resident (approximately 660 meters)	600 meters	4.80E-05