

**ENERGY FACILITY SITING COUNCIL BRIEFING**  
**On**  
**TROJAN FINAL SITE RADIOLOGICAL SURVEY**

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## **I. EXECUTIVE SUMMARY**

At the Energy Facility Siting Council meeting in April 2005, the Oregon Department of Energy (ODOE) will ask the Council to find that the decommissioning of the Trojan Nuclear Plant is complete, and that the site meets all criteria for unrestricted release. Unrestricted release means that the site can be safely used for any purpose, including residential use.

The process of collecting and analyzing the data to support unrestricted release is called the Final Radiological Survey, (or “final survey”). Portland General Electric (PGE), which owns the Trojan plant, is responsible for decommissioning and for the Final Survey. In December 2004, PGE submitted the last of 9 final survey reports, which include the data and analysis in support of a finding that the site meets the criteria for unrestricted release.

The technology involved in the final survey is unfamiliar to people outside the nuclear field. ODOE staff has prepared this briefing document, describing the concepts behind the federal guidance manual for performing such surveys. This federal manual is called MARSSIM, and it is the basis for a decision to approve unrestricted release of the site.

In order to present the information in a way that is helpful to the Council, we start with a Glossary of the terms used in radiation surveys and in MARSSIM. We continue with a history of Trojan decommissioning and the adoption of the state and federal criteria for unrestricted release. We discuss those criteria in detail and explain some of the technical concepts involved in proving that a site meets those criteria. We then describe how a group of federal agencies, including the U.S. Nuclear Regulatory Commission (NRC), wrote those concepts into a single manual (MARSSIM), applicable to nuclear installations across the country. We continue by describing how PGE applied this federal guidance manual in a site specific plan. Finally, we describe the ODOE review that forms the basis for our recommendation that the Council approve unrestricted release. We conclude by recommending that the Council find that Trojan site meets the criteria for unrestricted release.

ODOE’s review of the final survey was in close consultation with the NRC, and we relied greatly on the NRC for confirmatory surveys and technical expertise. Staff especially wants to thank Council member Martha Dibblee, who took an active part in the review and inspection.

We hope this briefing document helps the Council make a knowledgeable decision, and look forward to briefing the Council and answering questions in person at the upcoming meeting.

## **II. GLOSSARY**

To discuss the Trojan final survey, it helps to know the language. Here are acronyms and terms that are essential. We'll define them in more detail as we come across them.

**Radiation:** Release of energy from unstable atoms, in the form of particles or rays.

**Contamination:** Radioactive material in the wrong place. Contamination can be cleaned, but sometimes only with great difficulty.

**Background:** Radiation from natural sources or from weapons fallout, at locations unaffected by any nuclear facility. All areas have some level of background.

**Exposure:** Radiation when it impacts a person. Exposure is measured in units that account for the effect on the body.

**REM:** The unit of exposure. REM stands for “radiation equivalent in man”, and it includes factors that account for the impact of radiation on the human body.

**Millirem (mR):** A thousandth of a REM. The average Americans receive about 200 – 300 mR per year from background and medical sources, depending on where they live and what medical treatments they get.

**Survey:** The process of measuring, data collection and data analysis involved in determining how much radiation or contamination is in an area.

**Health Physics:** The profession that studies radiation, radiation safety and radiation measurement. Health Physicists sit for certification, much like accountants or engineers.

**Nuclides:** Atomic nuclei with different numbers of subatomic particles, giving them different radioactive properties. Different nuclides produce different levels of exposure, and they require different measurement techniques. For that reason, health physicists must find out what nuclides are present before planning a survey.

**NRC:** Nuclear Regulatory Commission, the federal agency that regulates all nuclear facilities including power, industrial and medical.

**CFR:** Code of Federal Regulations. The federal equivalent to Oregon Administrative Rules.

**NUREG:** detailed guidance documents issued by the NRC. NUREG's do not have the force of law, but following their guidance is usually the surest way to comply with the law.

**ALARA:** As Low As Reasonably Achievable. All nuclear facilities are required to keep radiation exposure ALARA, in addition to meeting numerical standards.

**MARSSIM:** The manual published in 1997 by a combination of federal agencies for performing final radiation surveys at many types of facilities, including power plants, weapons facilities, and fuel fabrication facilities.

**DCGL:** An important acronym that stands for Derived Concentration Guideline Limit. The DCGL concept is described in detail in MARSSIM. In brief, the DCGL is the acceptance criterion used by the plant personnel performing the final survey.

### **III. HISTORY OF TROJAN DECOMMISSIONING**

- 1993: PGE announced permanent plant closure
- 1993: first EFSC rulemaking on decommissioning. Most of OAR 345-026-0300 et seq. dates from that rulemaking. Two key issues emerged: “how clean is clean enough”; and assurance of adequate funds to complete the decommissioning. The Council adopted rules that required a decommissioning plan, stated what the decommissioning plan had to contain and set forth EFSC acceptance criteria for the decommissioning. The EFSC review process for the decommissioning plan included a contested case upon request.
- 1994: Second EFSC rulemaking on decommissioning; allowed PGE to remove certain large components (called “steam generators”) for burial at Hanford before the rest of the decommissioning plan had been through EFSC review. After multiple court challenges, PGE began removing the steam generators in December 1994.
- 1995: PGE submitted its decommissioning plan. ODOE staff issued a complete review report, held a joint public hearing with the NRC and issued notice of opportunity for contested case. No one requested a contested case, so there was none.
- 1996: EFSC approved the decommissioning plan and issued the “EFSC Decommissioning Order”
- 1998: Important revision of OAR 345-026-0390; changed final criteria for unrestricted release from a simple “radiation measurement” criterion to criteria based on projected dose to persons using the site in future. These criteria remain in use today. They match the NRC criteria at 10 CFR 20. The Council adopted these criteria in a rulemaking process.
- 2001: PGE began final survey with the Containment Dome.
- 2003: Transfer of spent fuel to the Independent Spent Fuel Storage Installation (ISFSI), enabling PGE to decommission the Fuel Building and Spent Fuel Pool.
- 2004: PGE completed the final survey, issued survey reports, and requested approval from federal and state regulatory agencies.

Some important conclusions from this history are:

1. The key question, then as now, was “how clean is clean enough”. The Council adopted rules answering this question in 1993, after a long and contentious rulemaking that featured two pre-draft workshops and three hearings. They changed it in 1998 in a second rulemaking. The criteria adopted in 1998 are what we use today. Not everyone agrees that the current standard is the right one, but it was the result of a full public process.
2. The rules include criteria for site release, but not for what evidence is needed to prove that the site meets those criteria. For that reason, we are following NRC guidance.

## **IV. A CLOSER LOOK AT THE FINAL SITE RELEASE CRITERIA**

The criteria for unrestricted release are at OAR 345-026-0370 and at 10 CFR 20.1204:

1. 25 mR/year above background to a person using the site for residential, occupational, or any other reasonable purpose.
2. As Low As Reasonable Achievable (ALARA) (above and beyond the basic 25 mR criterion)

### **Discussion**

- An average American is exposed to 200-300 mR/year from background. The NRC adopted the 25 mR standard after a multi-year federal rulemaking. It was a compromise between lower numbers advocated by EPA and others and higher numbers advocated by the industry.
- The standard does not call for removal of “all” residual radioactivity. Even if that were possible to accomplish, it would be impossible to prove. There is still radioactivity from natural background. Also, the measuring instruments have a lower limit of detection. For these reasons, the standard calls for removal of residual radioactivity to a level “As Low As Reasonably Achievable” (ALARA).
- Because the standard is an above background standard, the measurement of a background reference area is as important as the measurements in the plant.
- The 25 mR is from all sources. That includes direct radiation, ingestion, or inhalation. The licensee must assume that the site could be used for any purpose, up to and including a home, place of business, or even a family farm. NRC-approved computer codes, written at national labs, are used to model the site and project the dose in each year to a hypothetical person using the site. This modeling makes the new standard more complex than the pre-1998 one.
- The ALARA criterion requires the licensee to clean the site to below the 25 mR limit, to the extent “reasonable”. The licensee does a cost-benefit analysis, comparing the benefits of further cleanup with the costs of further cleanup. Those costs include the monetary costs and also the radiation exposure to the people doing the cleanup work. There’s a point of diminishing return. The NRC has issued a NUREG on how to perform this analysis. But regardless of cost, the site must meet the 25 mR criterion to qualify for unrestricted release.

## **V. PROVING THE 25 mR STANDARD IS MET – BASIC CONCEPTS**

**The Standard is in terms of dose to a hypothetical person using the site in the future:** We cannot measure that directly. We can only measure residual radiation using instruments, samples and lab analysis. So a survey engineer or Health Physicist must calculate a correlation between the measurements and instrument readings and dose to the hypothetical person.

**A survey is an iterative process:** You can’t take just one set of measurements and be done. PGE first took “characterization surveys” to inventory what was there before cleanup began. After a first level cleanup, there were intermediate surveys. When PGE believed a room was clean enough, they

did an “operational survey”. Once the operational survey showed that the room was ready, only then did they do the final survey. The Final Survey is the one of record. But the prior surveys provided input necessary to design the final survey.

**You can't survey a the whole site at once:** You divide the site into bite size pieces called “survey units”. A typical survey unit might be a single room. For a room with high suspected levels of contamination, the floor and lower walls could be one survey unit and the upper walls or ceiling would be another. Federal guidance suggests the right size for a survey unit. In a building that was highly affected by plant operations, 100 m<sup>2</sup> is a typical size. In a building like the turbine building that has little if any contamination, a survey unit might be 1000 m<sup>2</sup>. Common sense applies. PGE divided Trojan into 490 survey units, each with its own documentation package.

**Different measurement techniques are used:**

- Static measurements involve holding a detector in one place for period of time. They are accurate but they only see a specific spot.
- Scans involve moving the detector slowly across the surface. They are less accurate, but they see the whole surface area.
- Small probes are less accurate but they fit into tight places.
- Smears involve wiping the surface with filter paper, and taking the paper to a lab for analysis.
- You can take an actual sample of soil or concrete to a lab for highly accurate analysis.

**The survey depends on statistics:** No matter how many measurements you take, you are still using a finite number of measurements to represent the entire site. Whenever we use a sample of the population to draw a conclusion about the entire population, we use statistics to determine how many samples are needed, how accurate the results are, and what margin of error exists. The simplest way to reduce the margin of error is to use more measurements. With more measurements, you reduce the margin of error -- but it will never reach zero.

**Some areas of the plant require more intensive survey than others:** The reactor building and the spent fuel pool area were directly affected by plant operations. The turbine building was only slightly affected. Outside buildings like the administrative office were not affected. Federal guidance recommends categorizing the survey units into “Classes” with Class I the most affected and Class III the least. Class I survey units require more intensive survey than Classes II or III. These classifications are an important inspection topic.

**RECAP –**

- Perform characterization surveys to see what's there.
- Use characterization data to model dose to a person from the types of contamination present
- Use approved computer codes to correlate measurable quantities like instrument readings with dose to a person. Those measurable quantities become the acceptance criteria for the survey.
- Divide the plant up into reasonable size survey units.
- Use characterization data to classify survey units as class I, II or III.
- Use data from preliminary surveys to figure out size of survey unit, number of measurements, type of measurements and design of measurements that will produce a low margin of error.
- After initial cleanup, perform operational surveys to see if the site is ready for final survey.

- Take background reference measurements to establish background radiation level.
- Use the above information to write detailed design and procedures for the final survey.

These principles aren't unique to MARSSIM, but they are the foundation for MARSSIM.

## **VI. MARSSIM**

MARSSIM stands for "Multi Agency Radiation Site Survey Investigation Manual". The agencies include the NRC, the Environmental Protection Agency (EPA), and U.S. Departments of Defense and Energy. The idea was to create one survey method for commercial nuclear plants, fuel fabrication facilities, defense facilities, and any other contaminated facilities. Because several agencies were involved, MARSSIM is different from regulatory guidance published solely by the NRC. Colleagues with EPA experience have remarked that MARSSIM has much in common with EPA manuals for releasing non-nuclear sites.

MARSSIM takes the basic concepts described above and fleshes them about. Some things the Council should know about MARSSIM are:

1. MARSSIM is guidance, not regulation. It's not prescriptive. Much of the detail of a final survey depends on the type of facility (commercial, defense, medical), the types of radioactive contamination present, and the layout of the building or grounds.
2. MARSSIM leaves a lot to the judgement of the survey designer. An unqualified survey designer cannot just read the manual and produce a good survey. MARSSIM's target audience is an experienced Health Physicist.
3. Margin of error: Any statistical method has a margin of error. The survey engineer must design a survey to achieve an acceptable margin of error. The NRC generally looks for 95% confidence. That's what Trojan committed to. Much of the detail and the math in MARSSIM is there to guide the survey engineer in reaching the desired confidence level.
4. The statistical methods and calculations used by MARSSIM are not unique to the nuclear industry. They are the same methods and calculations found in any college statistics text.
5. The "DCGL" (a key concept!): At any site, there is a specific level of contamination that corresponds to 25 mR/year to the hypothetical person. That level depends on the type of contamination present, the site configuration, and the activities of the person. NRC-approved computer codes enable us to model the site, account for the type of contamination present, and calculate the level of contamination that will result in 25 mR to the person. In MARSSIM, that level is called the "DERIVED CONCENTRATION GUIDELINE LIMIT" or DCGL. When technicians perform the final survey, the DCGL is the acceptance criterion. The DCGL calculation was a top priority review item for ODOE and the NRC.

Although MARSSIM is not prescriptive, any survey consistent with MARSSIM will include certain steps. The licensee will:

1. Do site characterization to learn what types of radioactive materials are present.
2. Divide the site into Class I, Class II and Class III areas.

3. Run computer models to determine what level of contamination would cause 25 mR/year. The result would depend on the type of contamination found in the characterization.
4. Determine DCGL's based on those computer models
5. Divide the site into survey units, again using the MARSSIM guidelines.
6. Do an initial cleanup and preliminary surveys to prepare for the final survey
7. Use the equations and tables in MARSSIM to determine how many measurements to take in each survey unit.
8. Choose and measure background reference areas.
9. Design the survey – lay out a “grid” of measurement points
10. Take the measurements and document everything.

### **A More Detailed Look**

Importance of the “DCGL” : If PGE says a certain survey unit meets the criteria for unrestricted release, it means that measured contamination was “below the DCGL”. The DCGL is the acceptance criteria for the survey.

#### Custom versus Default DCGL

The DCGL is the level of contamination for a specific radioactive substance (“nuclide”) that will cause 25 mR/year to the person. If a mixture of radioactive nuclides is present, there are equations to compute a “composite” or “gross activity” DCGL. For most survey units, PGE technicians used the gross activity DCGL as the acceptance criterion.

The NRC has published Default DCGL's. These were computed using generic assumptions about the site, its future use, and the various ways that a person could be exposed. Since the assumptions are generic, the NRC had to use worst case assumptions throughout the calculation. This makes the Default DCGL's very conservative. If the site meets them then it is definitely clean. If a utility wants NRC approval as quickly as possible, using the default DCGL's is the path of least resistance.

The Default DCGL's are conservative enough that some sites could have trouble meeting them. Those sites have the option of using approved computer codes to model their own site and produce site-specific DCGL's. These may be more realistic than the NRC's default DCGL's. However, they might not be as conservative, and they would require tough regulatory review. Trojan used the Default DCGL's.

#### Scans and Static Measurements: the “bread and butter” of the final survey.

Static Measurements are the basic type of measurement that Trojan used. Trojan generally took static measurements with a detector that “sees” about 100 cm<sup>2</sup>. Static measurements are accurate but they only “see” the spot that was measured.

Scans are used to make sure that we don't inadvertently miss a contaminated spot in between the static measurements. Scans are not as accurate or as sensitive as static measurements, but they indicate if there's a spot that needs a closer look. MARSSIM recommends:

For class I: scan 100%

For class II: scan about 25%

For class III: take random scans

PGE also used smears and physical samples, especially in the early “characterization” surveys.

#### Correcting for Background

In some survey units, every measurement is below the DCGL. Those survey units are obviously clean, and there's no need for complex statistical tests.

In other survey units, some measurements are above the DCGL and some below. For those units, MARSSIM has equations and tables to determine if the survey unit as a whole passes or fails.

Background radiation may be so great that it is difficult to tell if the detectors are seeing background or contamination from the plant. For these cases, we measure radiation at a background reference area that is known to be unaffected by plant operations. For example – a sample of the same concrete used in plant construction, located outside the plant. MARSSIM provides equations and tables to compare the background reference area with the area being surveyed. Those equations and tables enable us to determine mathematically whether the two areas are the same or different in terms of radiological status. At Trojan, this technique was only needed for the spent fuel pool and areas affected by spent fuel operations. In other areas, the contamination was low enough to “pass” without a background reference area.

#### Elevated Areas

Occasionally there is one point of elevated contamination in a survey unit that is otherwise clean (below the DCGL). PGE's first option is to clean that point if it can reasonably be done (ALARA).

If the elevated area cannot reasonably be cleaned, MARSSIM has equations for determining an Elevated Area DCGL. PGE can create a special, smaller survey unit and compare it to the Elevated Area DCGL. They used this technique many times. This is a valid MARSSIM technique.

#### Bottom Line –

The Council should be aware that MARSSIM does not guarantee that every inch was measured, or that every measurement was below the DCGL. There are equations for determining how many measurements to take. There are three classes of survey units, and only class I requires 100% scan. A room can meet the acceptance criteria with some individual measurements above the DCGL. This is possible because the standard for final survey is based on overall dose to a hypothetical person over a full year, and because MARSSIM uses statistical methods to draw the overall conclusion.

#### Advanced Topics

Anyone who reads the full PGE survey report will come across more specialized terms, such as:

Relative Shift	LBGR (lower boundary of the grey area)
WRS test (Wilcoxon Ranked Sum)	Sign Test
MDC (minimum detectable concentration)	DQO (data quality objective)

Staff can explain these concepts, and how MARSSIM applies them, if the Council asks.

## **VII. PGE LICENSE TERMINATION PLAN (LTP)**

MARSSIM is not site specific. It is a generic guidance document that applies to commercial plants and other types of nuclear installations.

PGE wrote a site specific plan called the LTP (License Termination Plan). The LTP follows the MARSSIM guidance, but states in detail how PGE will:

- calculate DCGL's
- use information from early site characterization surveys to design the final survey
- select survey instruments
- divide the plant into survey units and classify them as class I, II or III.
- choose the type and number of measurements in each unit
- account for background radiation
- train the technicians
- ensure "chain of custody" of samples and data
- collect the data and document the results, and
- deal with unexpected developments

Some decisions that PGE wrote into the LTP include:

- the use of NRC default DCGL's
- a calculated "composite" DCGL with Cesium and Cobalt as the dominant contaminants
- a table showing the Survey Class (I, II, or III) of each room in the plant
- 5% maximum margin of error
- 30 static measurements used for all survey units, regardless of the individual room's status
- No credit for background, except in the Spent Fuel Pool

Reviewing the LTP was one of the most important inspection steps for ODOE and the NRC. The NRC issued written approval of the LTP in 2000. Although ODOE did not issue written approval of the LTP, we did review the LTP by going over the technical issues in detail with PGE personnel at the site.

In our review, we paid special attention to how PGE classified different parts of the site as Class I, II or III. We also paid special attention to PGE's calculation showing that 30 static measurements in each survey unit was adequate for every survey unit.

Once approved, the LTP became a binding commitment on PGE. In approving the final survey, the NRC found that it was "consistent with the LTP."

### **RECAP –**

- The standard is 25 mR/year, plus the ALARA requirement
- MARSSIM is generic guidance on how to show that a site meets the standard.
- The Trojan "LTP" is a site-specific survey plan that is consistent with MARSSIM but takes into account specific knowledge about the Trojan site.
- ODOE and NRC reviewed and approved the LTP before the survey began.

## **VIII. SPECIAL TROJAN ISSUES**

There are some topics so site specific that MARSSIM does not prescribe a survey method.

Instrument Calibration: The precision and accuracy of the instruments is as important as designing and performing the survey. MARSSIM does not prescribe instruments or calibration methods, because it is up to each licensee to have a good instrumentation and calibration program. That program is an important part of PGE's site specific survey program, and a key inspection topic for regulators. Because Council member Martha Dibblee specialized in this area during her career, we relied on Martha to review PGE's selection and use of instruments.

Groundwater – MARSSIM does not state how the surveyors should address groundwater. However, the NRC required PGE to perform groundwater studies. The groundwater studies are documented in a separate report called the “Trojan Nuclear Plant Groundwater Report, Revision 1” (May 2004).

In brief – PGE sampled and analyzed groundwater from 17 monitoring wells at various site locations. At one well located east of the Fuel Building, they found levels of tritium (a radioactive form of hydrogen) that were above background but were well below the EPA drinking water standard. These levels were evident immediately after rain events and subsided during dry spells. The highest individual measurement, taken in March 2004, showed levels that were about one fifth of the EPA standard. This would equal about 1 mR per year.

ODOE was fortunate to have a certified hydrogeologist in one of the agency's other divisions (the division that reviews Hanford activities). He reviewed the groundwater monitoring report and visited the site in 2004 to go over the groundwater investigation with PGE. In September 2004 he gave us his conclusions in writing, stating that he generally agreed with PGE's methods and conclusions. ODOE's recommendation to the Council is based on this staff member's review.

Embedded Pipes – Many of the steel pipes are embedded in concrete walls. The walls are thick enough to make their removal prohibitive. The authors of MARSSIM did not address embedded pipes. PGE created its own method for addressing embedded pipes and submitted it to ODOE and NRC for approval. The embedded pipes have their own DCGL, which takes into account the thickness of the steel and the configuration of the concrete walls. In separate calculations, PGE also showed that the residual contamination on the embedded pipes meets EFSC's standards for Exempt Concentration at OAR 345 Division 50.

Because the embedded pipe calculations were unique to Trojan, there was no federally approved method. PGE had to develop its own calculation method and its own modeling assumptions. PGE submitted these assumption to ODOE for approval. ODOE approved the assumptions in writing in May 2004. PGE later submitted the actual calculations, which ODOE approved in writing in February 2005. The calculations show that the residual contamination in the embedded pipes is below the “exempt concentration” of OAR 345 Division 50.

Spent Fuel Pool – In most areas, all of the measurements (or nearly all) were below the DCGL, even without subtracting out background radiation. These areas meet the criteria for unrestricted release outright, without need for special statistical tests.

The Spent Fuel Pool was an exception. The pool includes a particular form of radioactivity (“alpha”) that is hard to detect. The DCGL for this type of radiation is actually below the lower limit of detection for the measuring instruments. Therefore, PGE needed to use a more advanced method to determine if the pool met the unrestricted release criteria. PGE selected a background reference area (an area similar in construction to the pool, but known to be clean). They took measurements at the background reference area, took measurements at the pool, and used statistical tests to show that the two areas were statistically equivalent. This is an advanced MARSSIM technique. For this reason, we reviewed the spent fuel pool survey report more intensely than other buildings that were less complicated. Also for this reason, we went over the review of this area personally with the NRC.

#### Reporting the Results

For the final survey, PGE divided the plant into its various buildings. Each building is described in a separate final survey summary report. PGE submitted final survey reports for

Containment

The Turbine Building

The Main Steam Support Structure

The Auxiliary Building

The Fuel Building

The Spent Fuel Pool

Embedded Pipes

Plant Systems (mostly the Turbine and Condenser)

Support Facilities and Site Grounds

PGE divided each of these buildings into survey units. A typical survey unit is a single room. In all, there were 490 survey units. The final survey reports give summary information on each one. More detailed documentation packages for each survey unit are on file at the plant.

## IX. ODOE REVIEW

### Review of the PGE’s License Termination Plan (LTP)

Reviewed the LTP for consistency with the federal guidance in MARSSIM

Reviewed PGE classification of survey units (Class I, II or III)

Reviewed PGE method for determining DCGL’s

Reviewed calculation showing that 30 static samples is enough for all survey units

Reviewed PGE calculations of how much remediation beyond the 25 mR is ALARA.

### Review of PGE process for storing and tracking data, and training the survey technicians

Attended the same training as the survey technicians

Observed selected surveys in Containment Building and Auxiliary Building (the two buildings most likely to have residual contamination).

#### Review of survey results

The State did not do confirmatory surveys; but the NRC did extensive confirmatory surveys. Reviewed all of the survey reports PGE submitted for the nine buildings listed above

#### Review of calculations, position papers, and survey packages

Packages - For each of the 490 survey units, PGE created a detailed survey package. Each package has information on the technicians who did the survey, the instruments they used, calibration data on those instruments, the raw data collected, prints and drawings of the room with detailed location of any unusual readings, and any special calculations. The NRC reviewed about 30% of all survey packages. ODOE selected packages that contained special technical issues or out-of-the-ordinary results.

Calculations – Each survey report lists key calculations that PGE used to interpret the data and resolve technical issues during the survey. The calculations provide the basis for PGE's conclusions about the survey. Key calculations included – DCGL's for the various Trojan buildings; acceptance criteria for small isolated areas of elevated contamination; ALARA calculations for determining whether further cleaning was “reasonable”; treatment of background radiation; and special acceptance criteria for embedded pipes. Reviewing these calculations was a key step in determining that the Trojan final survey demonstrates that the site meets the 25 mR/year acceptance criterion.

## X. CONCLUSION AND STAFF RECOMMENDATION

- The use of site release criteria based on dose to a person presented special technical challenges.
- To meet these challenges, a set of federal agencies jointly authored a method called MARSSIM. PGE's final survey is based on MARSSIM.
- Because the surveyors are using a finite number of measurements to model the entire site, MARSSIM uses statistical methods to determine how many measurements are needed to draw a valid conclusion about the site.
- A key feature of MARSSIM is the “DCGL”; which stands for “Derived Concentration Guideline Limit”. The DCGL is the contamination level that corresponds to 25 mR/year dose to a person. It is one of the acceptance criteria for the final survey. Therefore, review of the DCGL calculation is one of the most important steps in reviewing the final survey.
- The DCGL is only a minimum acceptance criterion. The “ALARA” criterion requires PGE to remove contamination to the extent reasonably achievable.
- For almost all areas of the plant, measured residual contamination was well below the DCGL. Those areas met the criteria for unrestricted release outright, without using the more advanced statistical features in MARSSIM.

- For the spent fuel pool, PGE had to use the more advanced statistical methods in MARSSIM. For that reason, ODOE reviewed that area in more detail than most other areas, and reviewed those survey units personally with the NRC.
- ODOE used outside expertise to supplement our own. We don't have a certified Health Physicist in our division, but we consulted freely with the NRC's health physicists, attended training classes at Oak Ridge National Lab, received help from a certified hydrogeologist in another division to review groundwater issues, and received help from Council member Martha Dibblee for instrumentation and survey review.
- ODOE relied on the NRC for confirmatory surveys. Fortunately, the NRC took many more confirmatory surveys than they originally planned to. The NRC's confirmatory surveys and the favorable reports issued by the NRC are a key factor in ODOE's recommendation to the Council.

**ODOE Recommendation to the Council:** ODOE recommends that the Council find that the Trojan Final Survey:

- i. was performed in accordance with PGE's approved License Termination Plan,
- ii. is consistent with the federal guidance in MARSSIM, and
- iii. demonstrates that the site meets the criteria at OAR 345-026-0370 for unrestricted release.