URS Washington Division	**US-APWR PROJECT** **CALCULATION COVER SHEET**	Calculation No. LWM-25-05-500-001			
		Prel X	Final	Void	Revision D
CLIENT	Mitsubishi Heavy Industries	Discipline Nuclear & Process Engineering			
PROJECT TITLE	MHI US-APWR Luminant Conceptual Engineering	Project No. 28831			
SUBJECT/FEATURE	Determination of the Tritium Concentration in the Squaw Creek Reservoir	No. of Sheets: 34 (not including cover sheet)			

QUALITY CLASSIFICATIONS

☐ Q – Safety Related ☒ N - Non-Safety Related ☐ S - Special

CALCULATION OBJECTIVE

See Section 1.

CALCULATION RESULTS/CONCLUSIONS

See Sections 7 and 8.

UNVERIFIED ASSUMPTIONS/OPEN ITEMS

None.

DESIGN BASIS/SOURCE DATA

See Section 2.

SOURCES OF FORMULA AND REFERENCES

See Section 9.

METHOD OF VERIFICATION

☐ Design Review (Refer to NEP-07)

☒ Alternate Calculations

☐ Qualification Testing

FOR CALCULATIONS GENERATED BY COMPUTER PROGRAMS

Computer Program Name: N/A – Excel Spreadsheet used, with the equations hand checked as part of the calculation checking process

Rev. N/A

Status of Computer Verification: Yes ☐ No ☐

REV. NO.	REVISION REASON	CAL. BY	DATE	CHECK BY	DATE	APPROV. BY	DATE
A	Initial Issue	Peggy Caserto	Feb 28, 2008	Morgan Fakhrai	Feb 28, 2008	Irving Tsang	Feb 28, 2008
B	Revised to use a TDF of 0.6 based on Unit 1 and 2 data.	Peggy Caserto	March 13, 2008	Andy Woodruffe	March 13, 2008	Irving Tsang	March 13, 2008
C	Revised issue with minor changes.	Trupti Narielwala	June 27, 2008	Peggy Caserto	June 27, 2008	Irving Tsang	June 27, 2008
D	Revised issue with minor changes.	Sara Amitrani	Feb 19, 2009	Trupti Narielwala	Feb 19, 2009	Irving Tsang	March 10, 2009

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1 Introduction and Objective

The Squaw Creek Reservoir (SCR) receives effluent from the Comanche Peak Nuclear Power Station (CPNPS) Units 1 & 2. The effluent is slightly radioactive and contains tritium. The SCR currently has a tritium limit of 30,000 pCi/L (Reference [4]). In order to determine whether Units 3&4 can discharge liquid effluents into the SCR, the tritium concentration in the SCR must be calculated based on the current discharge from Units 1&2 and the projected discharge from Units 3&4.

The objective of this calculation is to determine the projected maximum tritium concentration in the SCR when all four units are operating based on the projected tritium content associated with the liquid effluents, the local meteorological conditions, other operating parameters, such as spill-over from the SCR to Squaw Creek, and natural radioactive decay. Inputs representative of baseline conditions, which predict the highest equilibrium concentration expected in the SCR when all 4 units are operating are to be determined, as well as inputs representative of average conditions which predict the average equilibrium concentration expected in the SCR when all 4 units are operating. The required diversion of liquid effluent from Units 3&4 such that the equilibrium concentration does not exceed the 30,000 pCi/L limit shall also be calculated.

Inputs to the calculation include sources and sinks of activity to and from the SCR. Sources of activity are the liquid effluents from Units 1 through 4, while sinks of activity are that carried with the flow that leaves the SCR as well as radioactive decay. Outflows are natural evaporation, forced evaporation, plant consumption, and spill-over. These are discussed in more detail in Section 2.

2 Inputs

2.1 Tritium Activity Inflow

Tritium produced in a light water reactor system is a function of core power level. The design basis tritium source value (in Ci/year) is determined by multiplying the MW(thermal) of the plant by a factor of 0.4 in accordance with the NUREG 0017 R1 method (Reference [10]). Also according to the NUREG 0017 R1 method, 90% of this tritium source is in the liquid effluent. MHI measures actual releases in the liquid effluent and compares that to the calculated release in accordance with NUREG 0017 R1. The ratio of the actual tritium release in the liquid effluent to the calculated tritium source value is identified as the Tritium Distribution Factor (TDF). Comanche Peak Units 1&2 operating data (Reference [9]) indicates that actual release in the liquid effluent is significantly lower than the calculated tritium source value. The current core thermal power of Units 1&2 is 3,565 MW(thermal) per unit. Multiplying 3,565 MW(thermal) by 2 units, then by the factor of .4 and the factor of .9, yields a calculated liquid tritium source value of 2,567 Ci/yr. The core thermal power produced by Units 3&4 is to be 4,451 MW(thermal) per unit. Multiplying 4,451 MW(thermal) by 2 units, then by the factor of .4 and the factor of .9, yields a design basis liquid tritium source value of 3,205 Ci/yr. As Units 3&4 are similar in design to Units 1&2, the tritium activity that is discharged in the effluent for Units 3&4 is calculated using the TDF determined from the data of Units 1&2. Calculation of the Units 1&2 TDF is presented in Section 5 of this calculation.

2.2 SCR Volume

The SCR level is maintained at an approximately constant average elevation of 775 feet (Reference [5]) with a depth of approximately 46 feet. The surface area of the SCR is 3,275 acres (Reference [5]), thus the volume is a constant value of approximately 151,000 acres-ft.

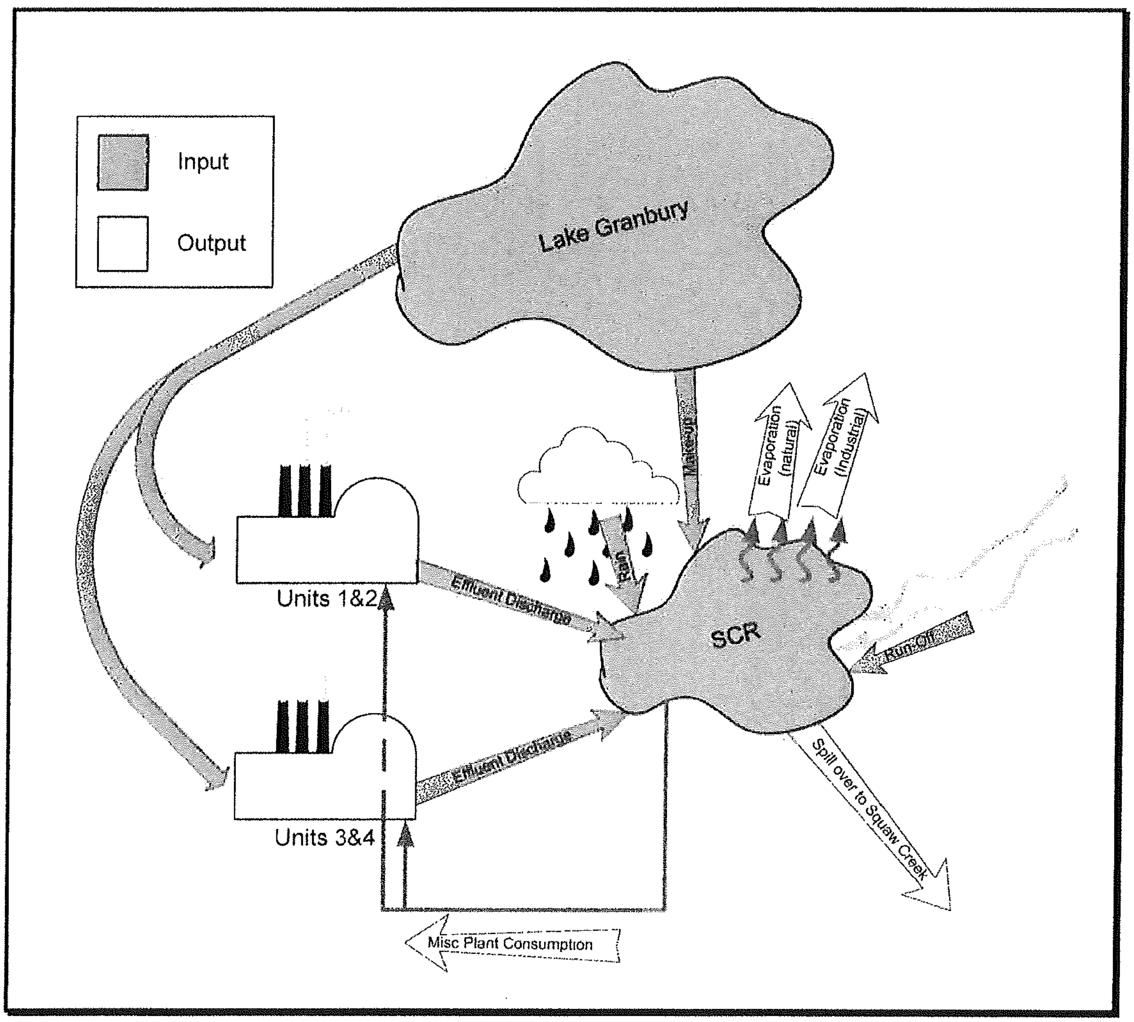
Historic measurements of SCR level indicate that the elevation changes from 774.5 to 775.1 feet. As this change is very small, this calculation assumes that the level, and hence the volume, are constant. It is also expected that the lake is irregular in shape and the depth may not be uniform. However, natural and forced evaporations are more surface area dependent so it is reasonable to assume that the volume of water in the SCR, and thus the tritium concentration, can be considered constant in order to facilitate this calculation. As a means to compensate for this approximation, the calculated tritium concentration from Units 1&2 is used to check against measured data and determine the sensitivity of the results. This is the basis for Case No. 5, as presented in Section 7.4.

In order to perform this calculation, it is assumed that the distribution of tritiated water and heat rejection (resulting forced evaporation) is evenly distributed across the reservoir (See Assumption [2]).

2.3 SCR Inflows and Outflows

Since the SCR volume is kept constant, the total inflows must equal the total outflows. A sketch illustrating the inflows and outflows considered in this calculation is shown in Figure 2-1.

Figure 2-1 – Sketch Showing Inflows and Outflows



Inflows include:

- Make-up water from Lake Granbury
- Rainfall
- Surface water run-off
- Plant effluent discharge

Outflows include:

- Natural evaporation
- Forced evaporation due to heat removed from the condensers of Units 1 and 2
- Miscellaneous plant consumption
- Spill-over from the SCR

As will be seen in Section 5, the calculation will involve only inflow and outflow streams that contain tritium. Discussion with Luminant indicates that currently makeup water is pumped from Lake Granbury to the plant and then discharged into the SCR, and that Lake Granbury water does not contain any tritium. Future operation of Units 3&4 will require makeup water from the same source. It is assumed that the rainfall does not contain tritiated water. (See assumption [5]). Thus the only inflow that needs to be parameterized is the liquid effluents in plant discharge, as described in Subsection 2.1.

2.3.1 Natural Evaporation

CPNPS resides in Region 510 of Texas. According to Reference [7], natural evaporation for Region 510 is approximately 80 inches annually. Local evaporation data recorded for Lake Granbury is lower than this, and in the range of 55 to 72 inches annually (Attachment E), with the average value of 62 inches. For calculation purpose the average value of natural evaporation is used. Evaporation is a source of tritium removal from the SCR, and evaporation rate increases with greater convective air currents near the surface of a body of water due to both air and water motion. The 62 inches of evaporation annually is equivalent to approximately 16,900 acre-feet of evaporation in volume annually.

2.3.2 Forced Evaporation

Forced evaporation is calculated to be 1 acre-ft per 1000 MWe-hour (Reference [3]). The average value of the calculated forced evaporation for Units 1&2 (1150 MWe each) is approximately 17,900 acres-feet for the operational years 1995 through 2006. Only Units 1&2 will release heat to the SCR causing forced evaporation, Units 3&4 will utilize cooling towers for heat removal. Forced evaporation will be a tritium outflow only while Units 1&2 are operating.

2.3.3 Plant Consumption

Miscellaneous plant consumption for two units during construction and startup is approximately 600 acres-ft per year based on plant data (Reference [3]). There is sporadic miscellaneous plant consumption thereafter, of amounts less than 600 acres-feet, ranging from zero to 570 acres-feet. The average of zero and 570 acres feet is close to 300 acres-feet for two units, thus for all four units operating it will be assumed that miscellaneous plant consumption is twice this, that is 600 acres-feet.

2.3.4 Spill-Over

Spill-over varies with plant and environmental need, as its purpose is to reduce thermal pollution and dissolved solids in the SCR. Spill-over involves opening up the dam between the SCR and Squaw Creek, releasing tritiated water into Squaw Creek. The average representative spill-over was determined to be approximately 32,900 acres-feet for the operational years 1990 through 2006 for Units 1&2 (data from Reference [3]). From various discussions with Luminant, 30,000 acres-feet of spill-over is the maximum agreed upon with the local water authorities unless there is heavy rainfall. The basis of this requirement is that spill-over from the SCR to Squaw Creek requires make-up from Lake Granbury; the local water authorities are fundamentally concerned about the volume of water diverted from Lake Granbury. Luminant intends to request a higher spill-over limit of up to 45,000 acres-feet in the future. For purpose of conservatism, a spill-over volume based on the 1996 through 2006 data is used in the calculations, that is 32,900 acres-feet.

2.4 Summary of Specific Design Parameters

♦ Activity Inflow	1,213-3,136 Ci/yr (See Table 5-1)	(Reference [6]) (Reference [9])
♦ SCR Volume	151,000 acres-ft	(Reference [5])
♦ Natural Evaporation Rate	16,900 acres-ft	(Reference [3])
♦ Forced Evaporation Rate	17,900 acres-ft	(Reference [3])
♦ Miscellaneous Plant Consumption (4 Units)	600 acres-ft	(Reference [3])
♦ Spill-over	32,900 acres-ft	(Reference [3])

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3 Assumptions

3.1 Technically Justified Assumptions

[1] It is assumed that the volume of the SCR remains constant at 151,000 acres-ft through the makeup and spillover process (Reference [2]).

[2] It is assumed that the SCR is a homogeneously mixed body of water.

[3] All units are assumed to operate at full power with a constant tritiated water generation rate. The assumption results in the most conservative approach to the calculation and is thus technically justified.

[4] It is assumed that Units 1&2 started commercial full-power operation in 1990 and are operate for forty years followed by 20 years of life extension services. It is also assumed that Units 3&4 start commercial full-power operation in 2020 and are operated for a total of sixty years. As the maximum tritium concentration is expected to occur when all four units are in operation, the commercial operation start date is not expected to change the maximum concentration but may shift the concentration curve earlier or later. This assumption is justified and therefore does not need verification.

[5] It is assumed that rainfall and runoff into the SCR does not contain any tritiated water.

3.2 Assumptions that Require Verification

There are no assumptions that require verification.

4 Applicable Limits

4.1 Offsite Dose Calculation Manual Limit

[1] The tritium concentration limit in SCR is 30,000 pCi/L (Reference [4]).

5 Methodology

The average annual liquid tritium effluent from Comanche Peak Units 1&2 operating data for the years 1996 through 2006 is 1,213 Ci, while the maximum for these years is 1,550 Ci (see Attachment A.5). The average liquid release correlates to a TDF of 0.47 (1,213 divided by 2,567) and the maximum liquid release correlates to a TDF of 0.60 (1,550 divided by 2,567). Thus the expected average tritium liquid releases from Units 1&2 is 1,213 Ci, and the range of activity from Units 3&4 is 1,506 Ci (3,205 multiplied by .47) to 1,923 Ci (3,205 multiplied by .60).

The objective is to calculate the activity in the SCR as a function of time, with the expectation that the equilibrium tritium concentrations reach separate maximum values when Units 1 and 2 are operating, when Units 1 through 4 are operating, and then when only Units 3 and 4 remain in operation.

By modeling the SCR as a spatially homogeneous control volume (Reference [12]), a differential equation can be written that describes the change in activity in the SCR. Sources and sinks of flow carrying activity that cross the boundary of the SCR must be accounted for. Sources of activity flowing into the SCR are those which come with the liquid effluents while sinks of activity flowing from the SCR (listed in Section 2.3) are not returned to the SCR. There is only one internal sink of activity in the SCR, which is radioactive decay.

$$\frac{dA}{dt} = -\lambda * A(t) + \dot{A}_{in}(t) - \sum \dot{A}_{out}(t)$$

A(t)	Activity in SCR as a function of time
$\dot{A}_{in}(t)$	Activity coming into SCR, that due to discharged liquid effluents
$\sum \dot{A}_{out}(t)$	Summation of all outflows of activity leaving SCR
λ	Decay constant of tritium

For this calculation it is assumed that the annual incoming activity is constant when two of the four units are operating or when all four units are operating. The values of the Units 3&4 incoming activity vary depending upon the tritium distribution factor (TDF) applied, as listed in Table 5-1.

Table 5-1 - Incoming Activity to the SCR

TDF as applied to Units 3&4	Activity added to SCR per year (Ci)		
	Units 1 & 2 (2,300 MWe)	Units 1, 2, 3, & 4 (5,700 MWe)	Units 3 & 4 (3,400 MWe)
0.47	1,213	2,719	1,506
0.60	1,213*	3,136	1,923

* Incoming activity values for Units 1 & 2 are based on SCR measured activity concentration data (see Attachment A.5). The average activity value over a ten-year period is used to provide a more realistic value of the activity contribution from Units 1 & 2. The maximum TDF is applied in the calculation of the tritium activity contribution from Units 3 & 4. Therefore, the total calculated for Units 1, 2, 3, & 4 is a more realistic representation of the total tritium concentration while conservatism is maintained based on the maximum TDF applied to the value calculated for Units 3 & 4. Rev D

Outflows carry activity with them. For any particular outflow stream:

$$\dot{A}_{out} = A(t) * \frac{\dot{V}_{out}}{V_{scr}}$$

$\dot{V}_{out}$ Volume flow rate of stream leaving SCR

V_{scr} Volume of the SCR

By assuming constant annual outflow streams and a constant volume of the SCR, the differential equation is a first order ordinary differential equation that can be solved using:

$$\exp\left(\left(\frac{\sum \dot{V}_{out}}{V_{scr}} + \lambda\right) * t\right)$$

As the integrating factor.

The resulting equation is:

$$A(t) = A_0 * \exp\left(-\left(\frac{\sum \dot{V}_{out}}{V_{scr}} + \lambda\right) * t\right) + \frac{\dot{A}_{in}}{\left(\frac{\sum \dot{V}_{out}}{V_{scr}} + \lambda\right)} * \left[1 - \exp\left(-\left(\frac{\sum \dot{V}_{out}}{V_{scr}} + \lambda\right) * t\right)\right]$$

A_0 Initial activity in the SCR for a given time period.

This equation is entered into an *Excel* spreadsheet and solved for the activity concentration of the SCR:

$$A_{conc}(t) = \frac{A(t)}{V_{scr}}$$

6 Calculations

The equations described in Section 5 were entered into an *Excel* (Versions 2000 and 2003) spreadsheet and the tritium equilibrium concentrations as a function of time determined for the time period when:

- Units 1 and 2 first start operation
- Units 3 and 4 are added (i.e. units 1, 2, 3 and 4 are in operation)
- Units 1 and 2 have retired and only Units 3 and 4 are operating

The parameters for the different study cases are summarized in Table 6-1. A brief description and basis for these cases is as follows:

- The first case listed is the baseline case, and is the case containing the values of the variables that are conservative for future plant operations. A TDF of .6 is applied to the Units 3&4 design basis tritium source value.
- Case No. 1 is the case which determines the required amount of diversion of Units 3 &4 effluent such that the concentration limit of the SCR is maintained within a 10% safety margin when a TDF of .6 is applied to the Units 3&4 design basis tritium source value. That is, it is the case which determines the required amount of diversion of Units 3 &4 effluent such that the concentration limit of the SCR is maintained at 27,000 pCi/L for the baseline case.
- Case No. 2 is the case which determines the required amount of diversion of Units 3 &4 effluent such that the concentration limit of the SCR is maintained within a 20% safety margin when a TDF of .6 is applied to the Units 3&4 design basis tritium source value. That is, it is the case which determines the required amount of diversion of Units 3 &4 effluent such that the concentration limit of the SCR is maintained at 24,000 pCi/L for the baseline case.
- Case No. 3 is the case containing the values of the variables that represents average (typical) conditions for future plant operations. A TDF of .47 is applied to the Units 3&4 design basis tritium source value.
- Case No. 4 is the case which determines the required amount of diversion of Units 3 &4 effluent such that the concentration limit of the SCR is maintained within a 20% safety margin when a TDF of .47 is applied to the Units 3&4 design basis tritium source value. That is, it is the case which determines the required amount of diversion of Units 3 &4 effluent such that the concentration limit of the SCR is maintained at 24,000 pCi/L for Case No. 3.

- Case No. 5 tests the model using the average SCR equilibrium tritium concentrations based on operating and environmental data from 1990 through 2006 for comparison with Units 1&2 operating data.

Table 6-1 - Summary of Study Cases

Case No.	TDF applied to Units 3 & 4	Outflows (acre*ft/yr)			
		Spillover	Natural Evaporation	Forced Evaporation	Misc. Plant Consumption
Baseline	**0.60**	32,900	16,900	17,900	600
1 (note 1)	**0.60**	32,900	16,900	17,900	600
2 (note 2)	**0.60**	32,900	16,900	17,900	600
3	**0.47**	32,900	16,900	17,900	600
4 (note 2)	**0.47**	32,900	16,900	17,900	600
5 (note 3)	-------	32,900	16,900	17,900	300

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Note 1: This case determines the portion of Units 3&4 effluent required to be diverted to an evaporation pond such that the tritium limit is not exceeded with a safety margin of 10%.

Note 2: This case determines the portion of Units 3&4 effluent required to be diverted to an evaporation pond such that the tritium limit is not exceeded with a safety margin of 20%.

Note 3: This case compares Units 1&2 operating data to the analytical model developed in this calculation.

7 Summary of Results

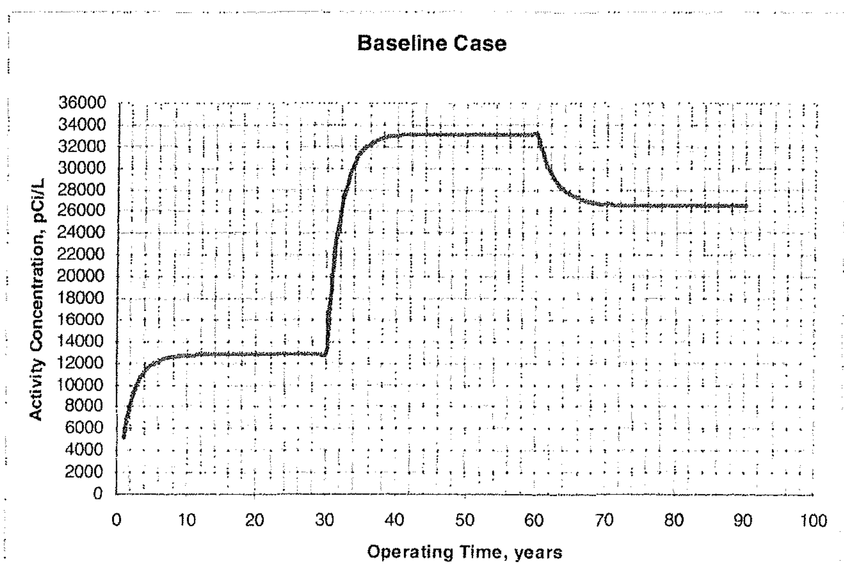
7.1 Baseline Case

For the baseline case, with the TDF of 0.60, the spill-over to Squaw Creek of 32,900 acres-ft, the natural evaporation of 16,900 acres-ft, the forced evaporation of 17,900 acres-ft, and the plant consumption of 600 acres-ft, the tritium equilibrium concentration is 12,800 pCi/L with Units 1 and 2 operating, 33,100 pCi/L with Units 1, 2, 3 and 4 operating, and 26,500 pCi/L with Units 3 and 4 operating. The graph is shown in Figure 7-1.

Baseline Case

- TDF 0.60
- Spillover 32,900 acres*ft
- Natural Evaporation 16,900 acres*ft
- Forced Evaporation 17,900 acres*ft
- Plant Consumption 600 acres*ft
- Equilibrium Concentration, all 4 units operating 33,100 pCi/L

Figure 7-1 - Baseline Case Equilibrium Concentrations



7.2 Cases No. 1 and 2: Required Fractions of Units 3&4 Effluent Diverted to the Evaporation Pond Considering a 10% and 20% Safety Margin

As evaporation and spill-over fluctuate seasonally, it is desirable to maintain the tritium concentration well below the 30,000 pCi/L limit.

- ***Thirty-one percent*** of the Units 3 &4 effluent must be diverted to an evaporation pond in order to maintain a SCR tritium equilibrium concentration of 27,000 pCi/L (10% safety margin).
- ***Forty-five percent*** of the Units 3 &4 effluent must be diverted to an evaporation pond in order to maintain a SCR tritium equilibrium concentration of 24,000 pCi/L (20% safety margin).

These cases utilize:

TDF	0.60
Spillover	32,900 acres*ft
Natural Evaporation	16,900 acres*ft
Forced Evaporation	17,900 acres*ft
Plant Consumption	600 acres*ft

The results for the cases are summarized in Table 7-1.

7.3 Case Nos. 3 and 4: Cases Utilizing a TDF of .47 for the Units 3&4 effluent

As evaporation and spill-over fluctuate seasonally, it is desirable to maintain the tritium concentration well below the 30,000 pCi/L limit.

- ***Zero percent*** (i.e., none) of the Units 3&4 effluent must be diverted to an evaporation pond in order to maintain a SCR tritium equilibrium concentration below 30,000 pCi/L (0% safety margin). The equilibrium concentration is 28,700 pCi/L.
- ***Twenty-nine percent*** of the Units 3 &4 effluent must be diverted to an evaporation pond in order to maintain a SCR tritium equilibrium concentration of 24,000 pCi/L (20% safety margin).

These cases utilize:

TDF	0.47
Spillover	32,900 acres*ft
Natural Evaporation	16,900 acres*ft
Forced Evaporation	17,900 acres*ft
Plant Consumption	600 acres*ft

7.4 Case No. 5: Calculated Tritium Equilibrium Concentration for Units 1&2

This test case uses the averages of operating data from References [3] and [9], yielding the average SCR tritium equilibrium concentrations for Units 1&2 predicted by the analytical model. This calculated equilibrium concentration is compared to the operating data to determine the model accuracy. As can be seen in Figure 7-2, the average equilibrium concentration calculated by the model is 12,800 pCi/L. This result approximately matches the averaged 12-year measured data of 11,700 pCi/L, within approximately 9%. The model can be adjusted to more closely match the measured data through the adjustment of the parameters such as spill-over, however, such adjustment is expected to result in higher uncertainties and thus is not recommended. This case utilizes a TDF of 0.47, spill-over to Squaw Creek of 32,900 acres-ft, natural evaporation of 16,900 acres-ft, forced evaporation of 17,900 acres-ft, and plant consumption of 300 acres-ft. | Rev D

Figure 7-2 - Tritium Equilibrium Concentration Model Compared to Data

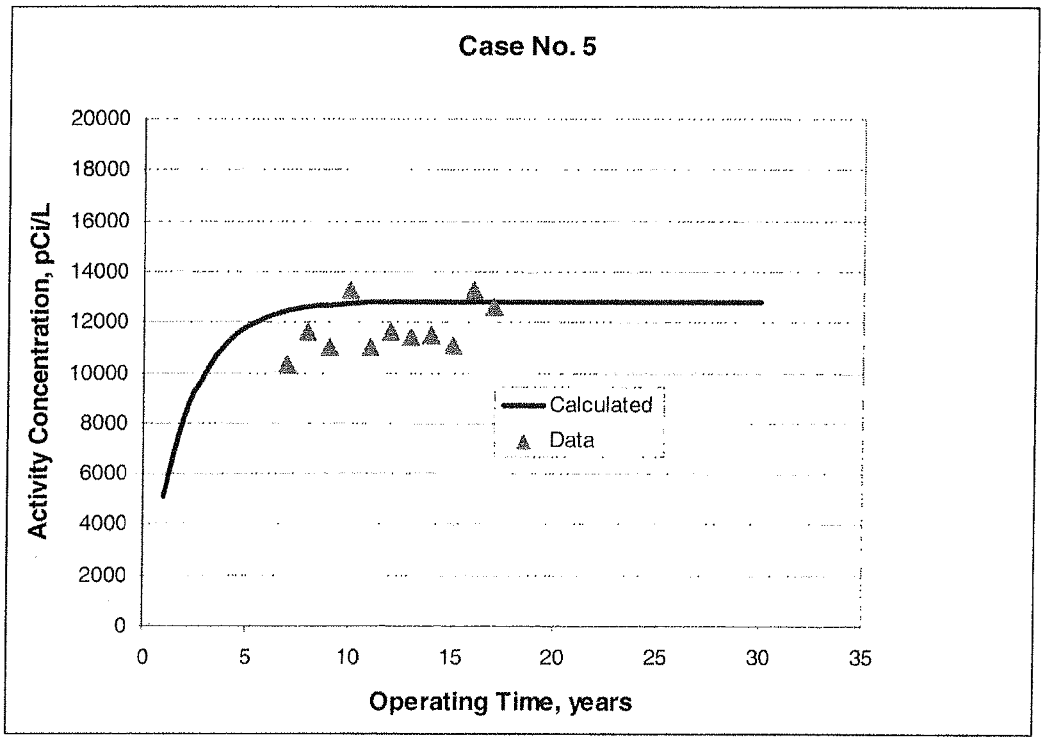


Table 7-1 – Summary of Results

Case No.	Tritium Equilibrium Concentration		
	Units 1 and 2 operating	Units 1, 2, 3 and 4 operating	Units 3 and 4 operating
Baseline	12,800	33,100	26,500
1	12,800	27,000	18,300
2	12,800	24,000	14,600
3	12,800	28,700	20,800
4	12,800	24,000	14,600
5	12,800	---------	---------

8 Conclusions

[1] Based on the site-specific meteorological data and the tritium distribution factor of 0.47 for Units 1&2 and 0.60 for Units 3&4, the projected maximum tritium concentration is 33,100 pCi/L, which exceeds the CPNPP administrative limit of 30,000 pCi/L for the Squaw Creek Reservoir when the four CPNPS units are operating.

[2] To stay within the 30,000 pCi/L limit, with a 10% safety margin, 31% of the Units 3&4 effluent will need to be diverted to an evaporation pond.

[3] To stay within the 30,000 pCi/L limit, with a 20% safety margin, 45% of the Units 3&4 effluent will need to be diverted to an evaporation pond.

[4] It has been demonstrated that the methodology used in this calculation agrees well with actual plant data from Units 1&2 thereby validating the approach.

9 References

[1] Deleted.

[2] Luminant Transmittal Number CP-200800880; from Matt Weeks, NuBuild CPNPP Units 3 &4, to Peggy Caserto, Washington Division of URS; June 26, 2008. Rev C*

[3] Texas Natural Resource Conservation Commission/Texas Water Development Board – Reports of Surface Water Used/Survey of Ground and Surface Water Use. 1990-2006.

[4] Comanche Peak Offsite Dose Calculation Manual, 01/93, Table 3.12-2.

[5] http://en.wikipedia.org/wiki/Squaw_Creek_Reservoir (See Attachment D)

[6] MHI DCD Table 11.1-3, "Tritium Sources".

[7] http://hyper20.twdb.state.tx.us/Evaporation/parseevap.cgi?quad=510&options=ET&submit=SUBMIT

[8] URS Washington Division, MHI US-APWR Project, Memorandum Number M-0013 "Monthly Evaporation Rates and Pan Factors for Lake Granbury". From Peggy Caserto to Irving Tsang, June 27, 2008. Rev C*

[9] Comanche Peak Radioactive Effluent Release Reports, 2001-2006.

[10] NUREG-0017R1 - Calculation Of Releases Of Radioactive Materials In Gaseous And Liquid Effluents From Pressurized Water Reactors (PWR-GALE Code), Revision 1. Nuclear Regulatory Commission.

[11] Comanche Peak FSAR, Units 1&2.

[12] "Thermodynamics and Engineering Approach", Cengel, Boles, Fifth Edition.

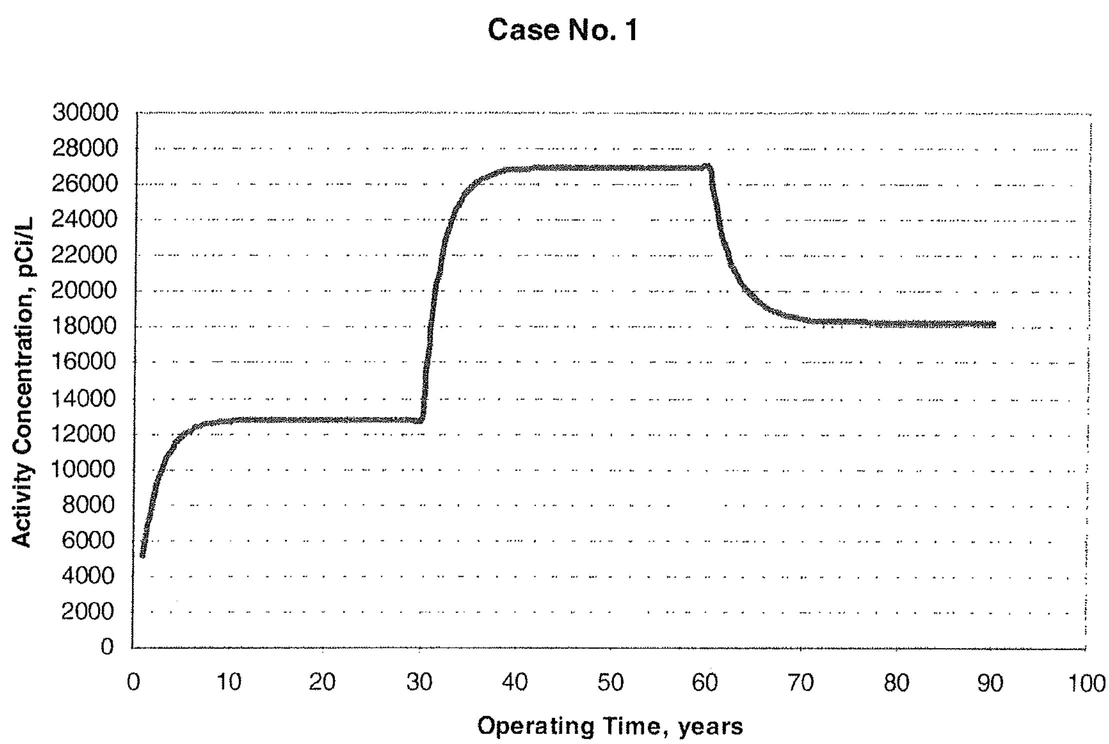
[13] "Requirements and Conditions of Analytical Work of the Tritium Concentration in the Squaw Creek Reservoir (SCR)", Document No. 6CS-1E-CP34-080005, Revision 0. Rev C*

*References were changed between Revision B and Revision C of this calculation. The revision bars have been added in Revision D as a corrective action resulting from a NUPIC audit. Rev D

Attachment A – Excel Graphs and Data

A.1 Case No. 1

Case No. 1 - 31% of Units 3&4 effluent diverted to evaporation pond	
TDF	0.60
Spillover	32,900 acres*ft
Natural Evaporation	16,900 acres*ft
Forced Evaporation	17,900 acres*ft
Plant Consumption	600 acres*ft
Equilibrium Concentration, all 4 units operating	27,000 pCi/L

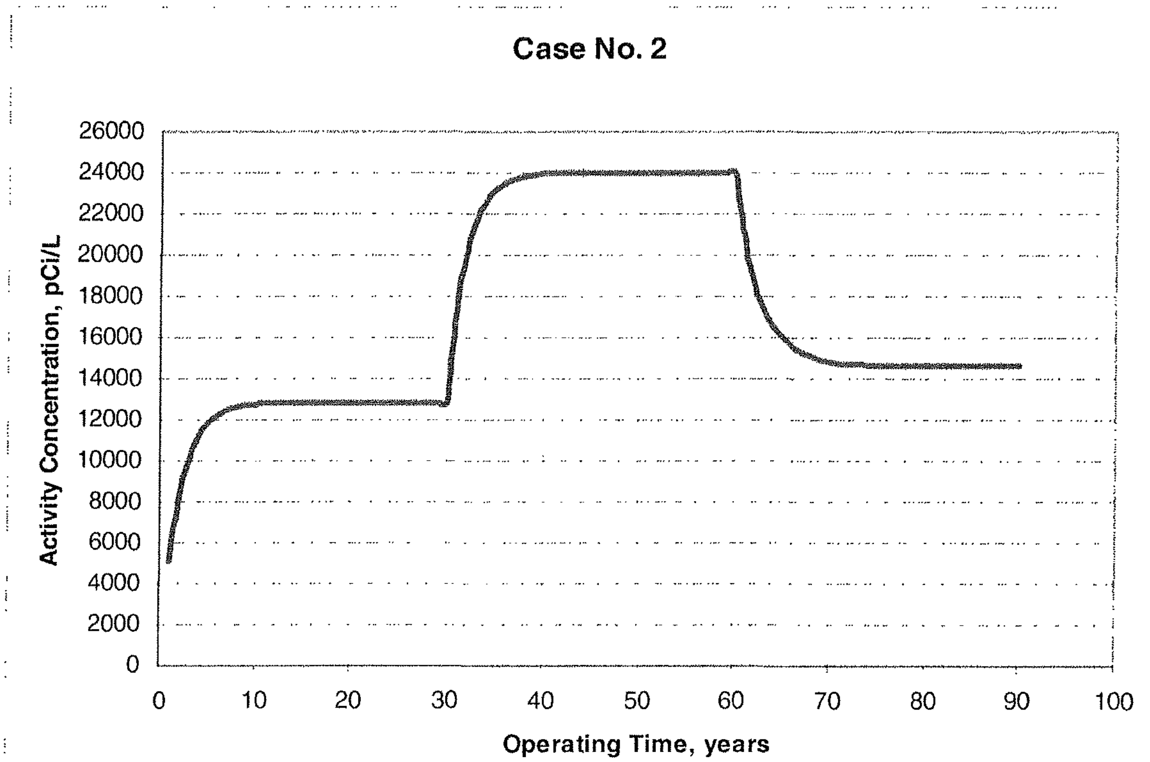


Project Title:	MHI US-APWR Luminant Conceptual Engineering	Calculation No.	28831-LWM-25-05-500-001	Sheet No.	A-2
Subject/Feature :	Determination of the Tritium Concentration in the Squaw Creek Reservoir			Rev	D

	A	B	C	D	E	F	G	H	I	J	K
1											
2						Spillover=32,900 acres*ft					
3						Natural Evaporation: 16,900 acres*ft					
4						Forced Evaporation: 17,900 acres*ft					
5						Plant Consumption: 600 acres*ft					
6											
7			Vout. aver	Vscr	lamda	Vout/Vscr+	Activity	exponential	A(t)		Activity
8	time (yr)	Ao, Ci	acre*ft/yr	acre*ft	1/yr	lamda	rate in, Ci	term		time(yr)	concentrat
9	1	0	68300	151000	=LN(2)/12.3	=C9/D9+E9	1213	=EXP(-(F9*A9))	=B9*H9+G9/F9*(1-H9)	1	=I9/186000000000*1000000000000
10	=A9+1	0	68300	151000	=LN(2)/12.3	=C10/D10+E10	1213	=EXP(-(F10*A10))	=B10*H10+G10/F10*(1-H10)	=J9+1	=I10/186000000000*1000000000000
11	=A10+1	0	68300	151000	=LN(2)/12.3	=C11/D11+E11	1213	=EXP(-(F11*A11))	=B11*H11+G11/F11*(1-H11)	=J10+1	=I11/186000000000*1000000000000
12	=A11+1	0	68300	151000	=LN(2)/12.3	=C12/D12+E12	1213	=EXP(-(F12*A12))	=B12*H12+G12/F12*(1-H12)	=J11+1	=I12/186000000000*1000000000000
13	=A12+1	0	68300	151000	=LN(2)/12.3	=C13/D13+E13	1213	=EXP(-(F13*A13))	=B13*H13+G13/F13*(1-H13)	=J12+1	=I13/186000000000*1000000000000
14	=A13+1	0	68300	151000	=LN(2)/12.3	=C14/D14+E14	1213	=EXP(-(F14*A14))	=B14*H14+G14/F14*(1-H14)	=J13+1	=I14/186000000000*1000000000000
15	=A14+1	0	68300	151000	=LN(2)/12.3	=C15/D15+E15	1213	=EXP(-(F15*A15))	=B15*H15+G15/F15*(1-H15)	=J14+1	=I15/186000000000*1000000000000
16	=A15+1	0	68300	151000	=LN(2)/12.3	=C16/D16+E16	1213	=EXP(-(F16*A16))	=B16*H16+G16/F16*(1-H16)	=J15+1	=I16/186000000000*1000000000000
17	=A16+1	0	68300	151000	=LN(2)/12.3	=C17/D17+E17	1213	=EXP(-(F17*A17))	=B17*H17+G17/F17*(1-H17)	=J16+1	=I17/186000000000*1000000000000
18	=A17+1	0	68300	151000	=LN(2)/12.3	=C18/D18+E18	1213	=EXP(-(F18*A18))	=B18*H18+G18/F18*(1-H18)	=J17+1	=I18/186000000000*1000000000000
19	=A18+1	0	68300	151000	=LN(2)/12.3	=C19/D19+E19	1213	=EXP(-(F19*A19))	=B19*H19+G19/F19*(1-H19)	=J18+1	=I19/186000000000*1000000000000
20	=A19+1	0	68300	151000	=LN(2)/12.3	=C20/D20+E20	1213	=EXP(-(F20*A20))	=B20*H20+G20/F20*(1-H20)	=J19+1	=I20/186000000000*1000000000000
21	=A20+1	0	68300	151000	=LN(2)/12.3	=C21/D21+E21	1213	=EXP(-(F21*A21))	=B21*H21+G21/F21*(1-H21)	=J20+1	=I21/186000000000*1000000000000
22	=A21+1	0	68300	151000	=LN(2)/12.3	=C22/D22+E22	1213	=EXP(-(F22*A22))	=B22*H22+G22/F22*(1-H22)	=J21+1	=I22/186000000000*1000000000000
23	=A22+1	0	68300	151000	=LN(2)/12.3	=C23/D23+E23	1213	=EXP(-(F23*A23))	=B23*H23+G23/F23*(1-H23)	=J22+1	=I23/186000000000*1000000000000
24	=A23+1	0	68300	151000	=LN(2)/12.3	=C24/D24+E24	1213	=EXP(-(F24*A24))	=B24*H24+G24/F24*(1-H24)	=J23+1	=I24/186000000000*1000000000000
25	=A24+1	0	68300	151000	=LN(2)/12.3	=C25/D25+E25	1213	=EXP(-(F25*A25))	=B25*H25+G25/F25*(1-H25)	=J24+1	=I25/186000000000*1000000000000
26	=A25+1	0	68300	151000	=LN(2)/12.3	=C26/D26+E26	1213	=EXP(-(F26*A26))	=B26*H26+G26/F26*(1-H26)	=J25+1	=I26/186000000000*1000000000000
27	=A26+1	0	68300	151000	=LN(2)/12.3	=C27/D27+E27	1213	=EXP(-(F27*A27))	=B27*H27+G27/F27*(1-H27)	=J26+1	=I27/186000000000*1000000000000
28	=A27+1	0	68300	151000	=LN(2)/12.3	=C28/D28+E28	1213	=EXP(-(F28*A28))	=B28*H28+G28/F28*(1-H28)	=J27+1	=I28/186000000000*1000000000000
29	=A28+1	0	68300	151000	=LN(2)/12.3	=C29/D29+E29	1213	=EXP(-(F29*A29))	=B29*H29+G29/F29*(1-H29)	=J28+1	=I29/186000000000*1000000000000
30	=A29+1	0	68300	151000	=LN(2)/12.3	=C30/D30+E30	1213	=EXP(-(F30*A30))	=B30*H30+G30/F30*(1-H30)	=J29+1	=I30/186000000000*1000000000000
31	=A30+1	0	68300	151000	=LN(2)/12.3	=C31/D31+E31	1213	=EXP(-(F31*A31))	=B31*H31+G31/F31*(1-H31)	=J30+1	=I31/186000000000*1000000000000
32	=A31+1	0	68300	151000	=LN(2)/12.3	=C32/D32+E32	1213	=EXP(-(F32*A32))	=B32*H32+G32/F32*(1-H32)	=J31+1	=I32/186000000000*1000000000000
33	=A32+1	0	68300	151000	=LN(2)/12.3	=C33/D33+E33	1213	=EXP(-(F33*A33))	=B33*H33+G33/F33*(1-H33)	=J32+1	=I33/186000000000*1000000000000
34	=A33+1	0	68300	151000	=LN(2)/12.3	=C34/D34+E34	1213	=EXP(-(F34*A34))	=B34*H34+G34/F34*(1-H34)	=J33+1	=I34/186000000000*1000000000000
35	=A34+1	0	68300	151000	=LN(2)/12.3	=C35/D35+E35	1213	=EXP(-(F35*A35))	=B35*H35+G35/F35*(1-H35)	=J34+1	=I35/186000000000*1000000000000
36	=A35+1	0	68300	151000	=LN(2)/12.3	=C36/D36+E36	1213	=EXP(-(F36*A36))	=B36*H36+G36/F36*(1-H36)	=J35+1	=I36/186000000000*1000000000000
37	=A36+1	0	68300	151000	=LN(2)/12.3	=C37/D37+E37	1213	=EXP(-(F37*A37))	=B37*H37+G37/F37*(1-H37)	=J36+1	=I37/186000000000*1000000000000
38	=A37+1	0	68300	151000	=LN(2)/12.3	=C38/D38+E38	1213	=EXP(-(F38*A38))	=B38*H38+G38/F38*(1-H38)	=J37+1	=I38/186000000000*1000000000000
39	1	2385	68300	151000	=LN(2)/12.3	=C39/D39+E39	2275	=EXP(-(F39*A39))	=B39*H39+G39/F39*(1-H39)	=J38+1	=I39/186000000000*1000000000000
40	=A39+1	2385	68300	151000	=LN(2)/12.3	=C40/D40+E40	2275	=EXP(-(F40*A40))	=B40*H40+G40/F40*(1-H40)	=J39+1	=I40/186000000000*1000000000000
41	=A40+1	2385	68300	151000	=LN(2)/12.3	=C41/D41+E41	2275	=EXP(-(F41*A41))	=B41*H41+G41/F41*(1-H41)	=J40+1	=I41/186000000000*1000000000000
42	=A41+1	2385	68300	151000	=LN(2)/12.3	=C42/D42+E42	2275	=EXP(-(F42*A42))	=B42*H42+G42/F42*(1-H42)	=J41+1	=I42/186000000000*1000000000000
43	=A42+1	2385	68300	151000	=LN(2)/12.3	=C43/D43+E43	2275	=EXP(-(F43*A43))	=B43*H43+G43/F43*(1-H43)	=J42+1	=I43/186000000000*1000000000000
44	=A43+1	2385	68300	151000	=LN(2)/12.3	=C44/D44+E44	2275	=EXP(-(F44*A44))	=B44*H44+G44/F44*(1-H44)	=J43+1	=I44/186000000000*1000000000000
45	=A44+1	2385	68300	151000	=LN(2)/12.3	=C45/D45+E45	2275	=EXP(-(F45*A45))	=B45*H45+G45/F45*(1-H45)	=J44+1	=I45/186000000000*1000000000000
46	=A45+1	2385	68300	151000	=LN(2)/12.3	=C46/D46+E46	2275	=EXP(-(F46*A46))	=B46*H46+G46/F46*(1-H46)	=J45+1	=I46/186000000000*1000000000000
47	=A46+1	2385	68300	151000	=LN(2)/12.3	=C47/D47+E47	2275	=EXP(-(F47*A47))	=B47*H47+G47/F47*(1-H47)	=J46+1	=I47/186000000000*1000000000000

A.2 Case No. 2

Case No. 2 - 45% of Units 3&4 effluent diverted to evaporation pond	
TDF	0.60
Spillover	32,900 acres*ft
Natural Evaporation	16,900 acres*ft
Forced Evaporation	17,900 acres*ft
Plant Consumption	600 acres*ft
Equilibrium Concentration, all 4 units operating	24,000 pCi/L



Project Title:	MHI US-APWR Luminant Conceptual Engineering	Calculation No.	28831-LWM-25-05-500-001	Sheet No.	A-4
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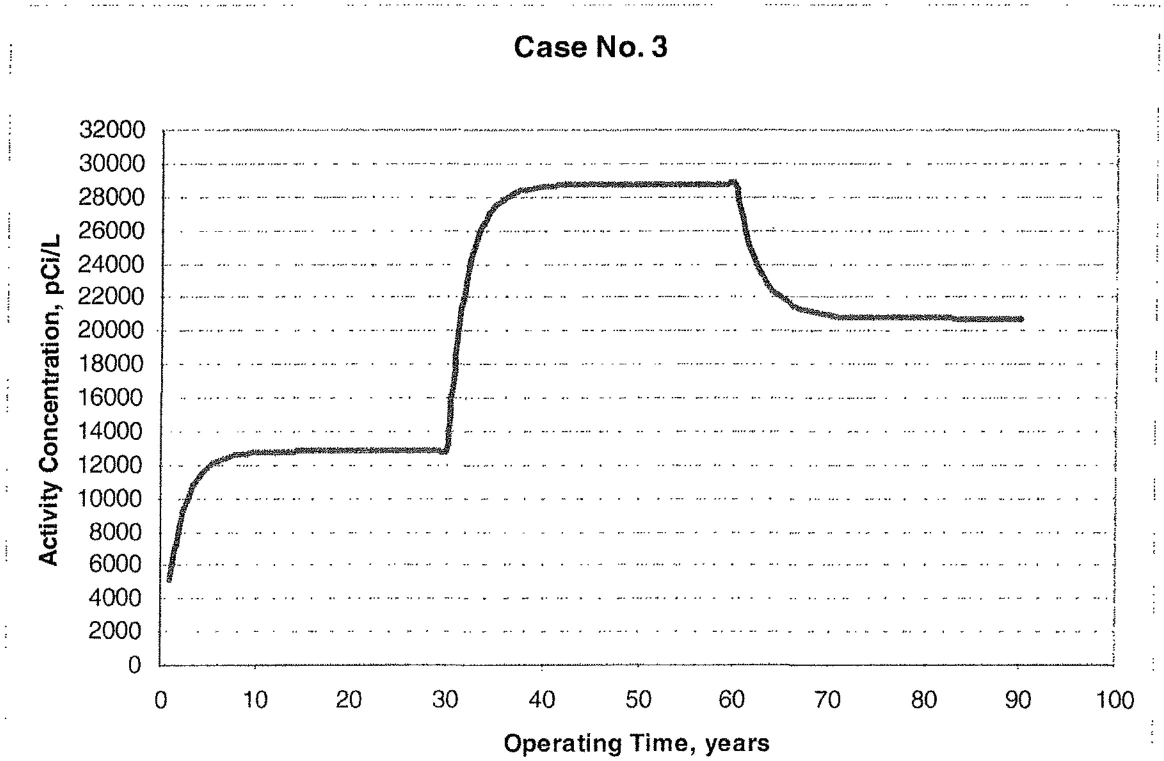
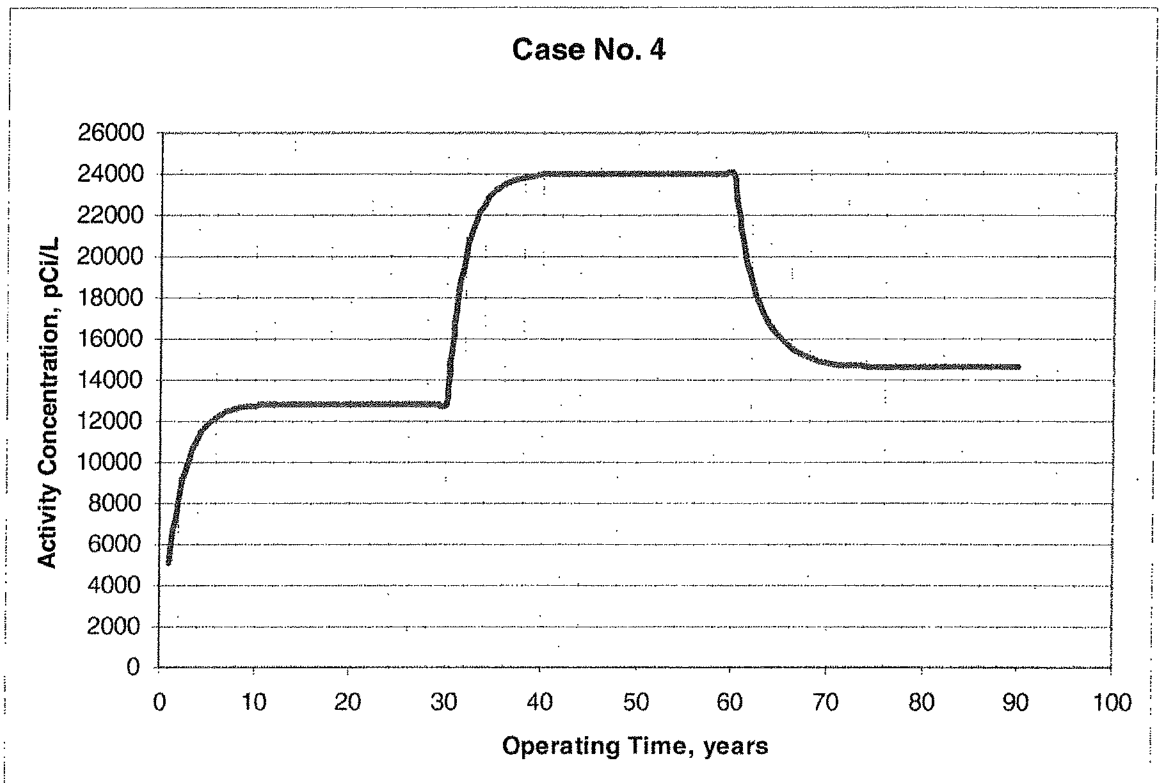
A.3 Case No. 3

Case No. 3	
TDF	0.47
Spillover	32,900 acres*ft
Natural Evaporation	16,900 acres*ft
Forced Evaporation	17,900 acres*ft
Plant Consumption	600 acres*ft
Equilibrium Concentration, all 4 units operating	28,700 pCi/L



A.4 Case No. 4

Case No. 4 - 29% of Units 3&4 effluent diverted to evaporation pond	
TDF	0.47
Spillover	32,900 acres*ft
Natural Evaporation	16,900 acres*ft
Forced Evaporation	17,900 acres*ft
Plant Consumption	600 acres*ft
Equilibrium Concentration, all 4 units operating	24,000 pCi/L



A.5 Units 1&2 Effluent Activities and SCR Measured Activity Concentrations

The following is measured liquid effluent and SCR activity concentration data from Reference [9]:

Year	Activity Into SCR, Curies	Measured Activity Concentration in the SCR (pCi/L)
1996	986	10,375
1997	1,455	11,600
1998	669	11,000
1999	1,550	13,250
2000	1,223	11,000
2001	931	11,650
2002	1,391	11,400
2003	1,430	11,475
2004	1,080	11,094
2005	1,480	13,300
2006	1,520	12,600

The average of the activity into the SCR data is 1,213 Curies. The average of the measured activity concentration data is 11,700 pCi/L.

Attachment B- Deleted

Attachment C - Operating Guide for Lake Granbury Make-Up Pumps[1]

[illegible]

Project Title:	MHI US-APWR Luminant Conceptual Engineering	Calculation No.	28831-LWM-25-05-500-001	Sheet No.	C-2
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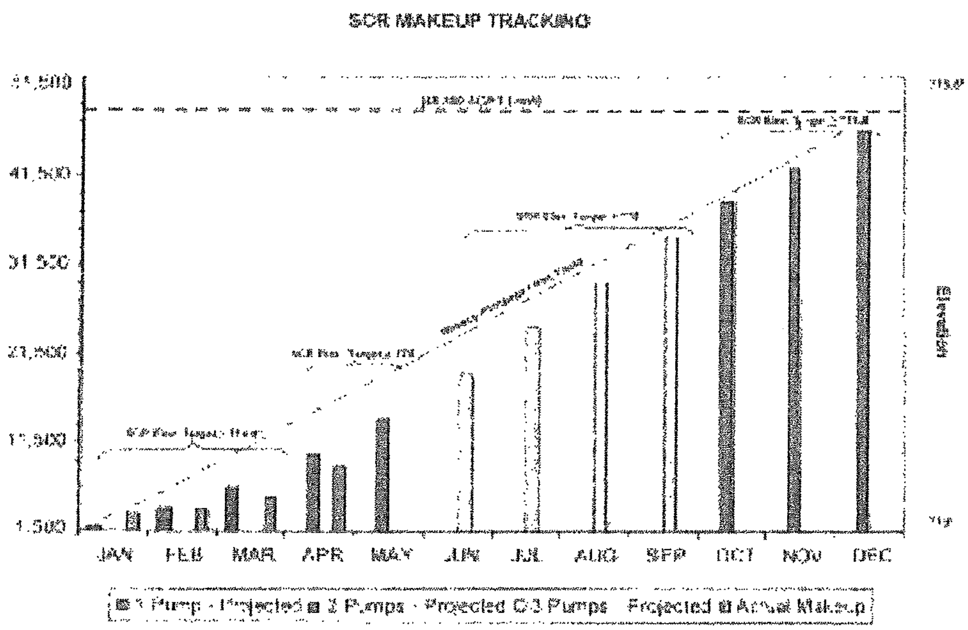


(1) From Reference [2].

Project Title:	MHI US-APWR Luminant Conceptual Engineering	Calculation No.	28831-LWM-25-05-500-001	Sheet No.	D-1
Subject/Feature:	Determination of the Tritium Concentration in the Squaw Creek Reservoir			Rev	D

Attachment D - Squaw Creek Reservoir Web Page

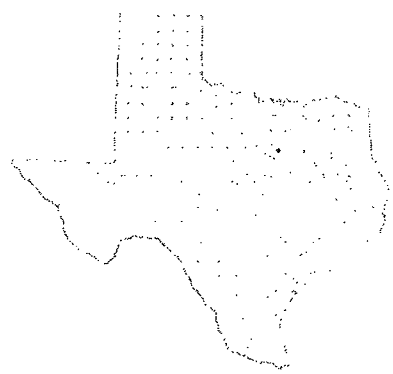
Squaw Creek Reservoir

Coordinates 32 32132, -97 7882

From Wikipedia, the free encyclopedia

Squaw Creek Reservoir is an 3,275 acre (13 3 km²) impoundment located between Glen Rose, Texas and Granbury, Texas. The primary purpose is cooling for Comanche Peak Nuclear Generating Station During full operation of both units of Comanche Peak 2 2 million gallons of water are pumped through the plant's main condensers from Squaw Creek Reservoir [1]

Squaw Creek Reservoir	
Location	Somervell County, Texas
Coordinates	32°19.2792'N, 97°47 2920'W
Lake type	Reservoir
Primary sources	Squaw Creek
Primary outflows	Squaw Creek
Basin countries	United States
Surface area	3,275 acres (13 25 km²)
Average depth	46 ft (14 m)
Max depth	125 ft (38 1 m)
Water volume	151,418 acre feet (187,000,000 m³)
Surface elevation	775 ft (236 m)



The water is relatively clear and provides good bass fishing The shoreline is rocky

Contents

History

The reservoir was built by TXU for cooling for Comanche Peak in the 1970s. It was impounded in 1979 and took 2 years to fill.

Fish populations

In various years the lake has been stocked with channel catfish, largemouth bass, smallmouth bass, shad and walleye.[2]

Recreational use

Fishing is the primary recreational activity at the reservoir. There are camping and fishing facilities at the 475 acre (1.9 km²) Squaw Creek Park across from the nuclear plant.

Location and access

Squaw Creek Reservoir is located at 32°19′17″N, 97°47′05″W (32.32132, -97.7882)[GR] near Glen Rose. It is accessed off State Highway 144 (Texas).

The reservoir is managed by TXU and has been closed to the public since the attacks on September 11, 2001. Access to the reservoir was previously allowed via Squaw Creek Park.

Controversy over public access

There have been several attempts in recent years to get the lake re-opened to the public by anglers as well as recreational boaters.[3] [4]
On February 26, 2007 TXU agreed to an estimated 45 billion dollar buyout by a group of private equity firms led by Kohlberg Kravis Roberts and Company and Texas Pacific Group. This buyout has rekindled hopes the reservoir will one day be re-opened to the public.

References

1. ^ TXU article about Comanche Peak (http://www.txucorp.com/power-plants/comanche_peak.aspx)
2. ^ Stocking History for Squaw Creek Reservoir by Texas Parks & Wildlife (http://www.tpwd.state.tx.us/fishboat/fish/action/stock_bywater.php?WB_code=0690)
3. ^ Open squaw creek website (http://www.opensquawcreek.com/)
4. ^ Online petition to re-open squaw creek (http://www.petitiononline.com/squaw/petition.html)

- Squaw Creek Reservoir is at coordinates 32.32132, -97.7882

Retrieved from "http://en.wikipedia.org/wiki/Squaw_Creek_Reservoir"

Categories: Lakes of Texas | Reservoirs in the United States | Somervell County, Texas

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Attachment E: Evaporation Data for Lake Granbury(1)

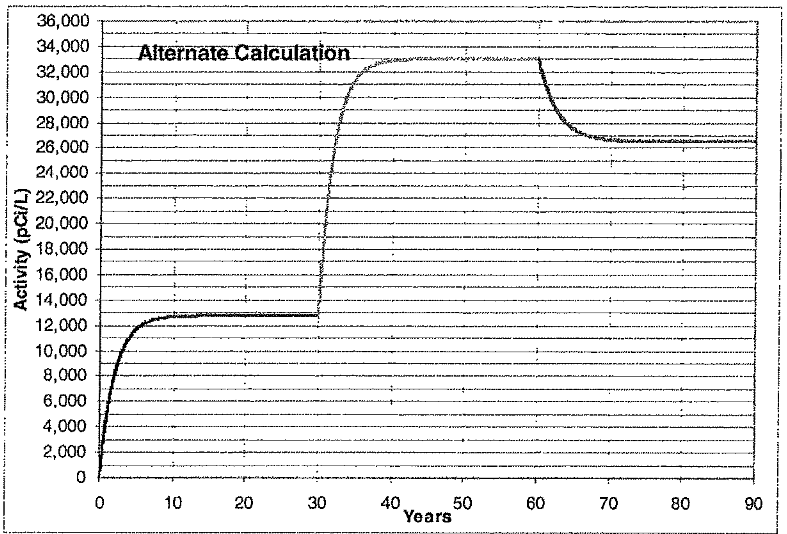
Mean Monthly Evaporation Data for Lake Granbury

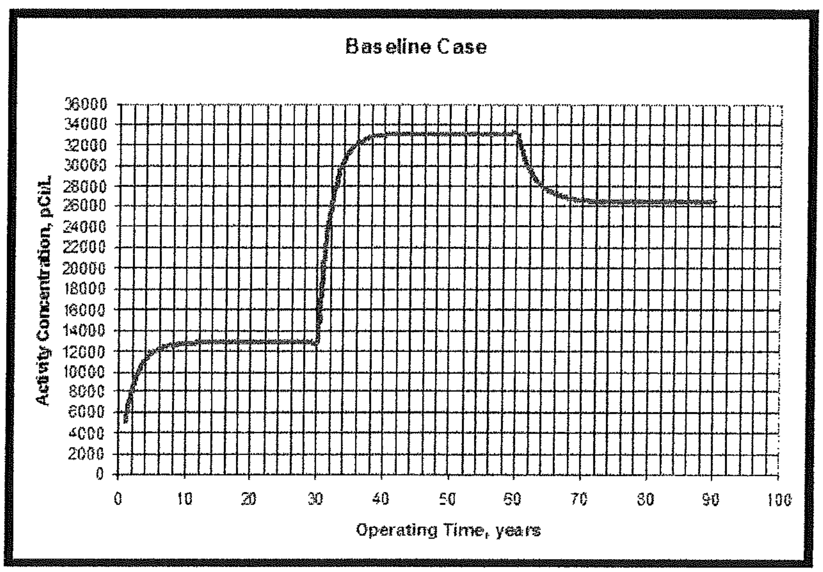
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1993	1.85	2.26	3.56	4.70	5.56	6.83	11.67	10.51	7.99	4.99	2.70	2.54	65.16
1994	2.04	1.96	3.37	4.91	4.75	7.88	9.35	9.45	5.90	4.70	3.05	1.77	59.11
1995	1.24	0.94	2.41	4.51	5.22	7.02	8.91	7.45	6.19	6.32	3.96	1.99	56.16
1996	1.19	1.27	3.59	6.04	8.40	7.94	9.14	7.12	5.35	4.75	2.81	1.40	59.01
1997	1.19	0.94	2.44	3.88	5.00	6.77	9.61	8.68	8.31	5.61	2.91	2.56	57.89
1998	2.44	1.97	3.97	5.52	7.13	9.31	11.56	9.37	7.34	4.95	2.63	1.84	68.03
1999	1.19	0.94	3.10	6.91	5.86	6.56	10.18	11.76	8.47	6.19	4.15	3.08	68.39
2000	1.19	0.97	1.89	4.81	6.97	5.78	10.63	11.77	8.99	4.01	1.68	1.13	59.83
2001	1.48	2.00	2.63	3.87	6.11	7.85	10.56	8.90	5.98	5.43	3.08	2.71	60.62
2002	2.49	2.37	3.19	4.01	6.12	7.09	7.52	9.52	7.17	3.80	3.64	2.33	59.24
2003	2.26	1.59	3.44	5.36	5.39	6.95	9.67	9.07	5.82	5.06	3.65	3.62	61.87
2004	2.09	1.97	3.52	3.60	5.84	5.51	7.99	7.65	6.34	4.49	3.27	2.54	54.81
2005	2.40	2.23	3.35	4.92	5.09	7.56	8.35	7.33	7.94	5.44	4.71	2.98	62.31
2006	3.83	2.87	4.28	5.48	7.13	8.64	9.57	10.35	7.54	5.31	4.17	2.77	71.94
Average	1.92	1.73	3.20	4.89	6.04	7.26	9.62	9.21	7.10	5.07	3.31	2.38	61.74

(1) See Reference [8].

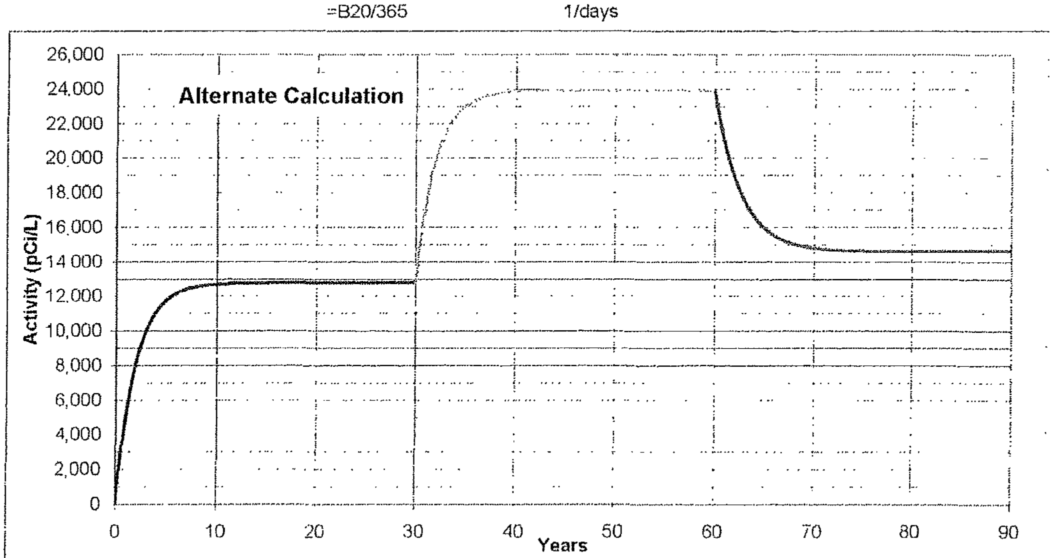
Attachment F – Alternate Calculation

An alternate calculation was performed to check the methodology. This alternate calculation used different methodology than outlined in this calculation, and did not solve any differential equations. Instead the activity added into the SCR was determined on a daily basis and the loss due to SCR losses and radioactive decay were deducted. This was repeated for every day out to 90 years. The results were identical. This can be seen by comparing the base case activity graphs shown below. This validates that the approach is acceptable.





	A	B	C	D	E	F	G
1	Annual Ci Input from Units 1 and 2	1213	TDF	Without TDF			
2	Annual Ci Inpu from Units 3 and 4	=D2*C2*(1-B3)	0.6	3205			
3	Units 3 and 4 Diversion	0.45					
4	**TOTAL Input from Units 1, 2, 3 and 4**	**=SUM(B1:B2)**					
5							
6	SCR Volume	151000	acres-ft	=B6*43560	ft^3	**=D6*28.31684659**	**liters**
7	Tritium Half Life	=12.2*365	days				
8	Tritium Decay Constant	=LN(2)/B7	1/days				
9							
10	Spillover	32900	acres-ft	=B10*43560	ft^3		
11	Natural Evaporation	16900	acres-ft	=B11*43560	ft^3		
12	Forced Evaporation	17900	acres-ft	=B12*43560	ft^3		
13	Plant Consumption	600	acres-ft	=B13*43560	ft^3		
14	TOTAL without Forced Evaporation	=SUM(B10:B11,300)	acres-ft	=B14*43560	ft^3		
15	**TOTAL**	**=SUM(B10:B13)**	**acres-ft**	**=B15*43560**	ft^3		
16							
17	SCR Loss decay constant	=B15/B6	1/years				
18		=B17/365	1/days				
19							
20	SCR Loss decay constant (No forced)	=B14/B6	1/years				
21		=B20/365	1/days				



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	A	B	C	D	E	F
1			Starting Activity		0	Ci
2						
3	Days	Years	Starting Activity (Ci)	Activity Added (Ci)	TOTAL Activity (Ci)	Loss Due to Decay (Ci)
4	1	=A4/365	=E1	=One_Two/365	=C4+D4	=E4*Inputs!$B$8
5	2	=A5/365	=I4	=One_Two/365	=C5+D5	=E5*Inputs!$B$8
6	3	=A6/365	=I5	=One_Two/365	=C6+D6	=E6*Inputs!$B$8
7	4	=A7/365	=I6	=One_Two/365	=C7+D7	=E7*Inputs!$B$8
8	5	=A8/365	=I7	=One_Two/365	=C8+D8	=E8*Inputs!$B$8
9	6	=A9/365	=I8	=One_Two/365	=C9+D9	=E9*Inputs!$B$8
10	7	=A10/365	=I9	=One_Two/365	=C10+D10	=E10*Inputs!$B$8
11	8	=A11/365	=I10	=One_Two/365	=C11+D11	=E11*Inputs!$B$8
12	9	=A12/365	=I11	=One_Two/365	=C12+D12	=E12*Inputs!$B$8
13	10	=A13/365	=I12	=One_Two/365	=C13+D13	=E13*Inputs!$B$8
14	11	=A14/365	=I13	=One_Two/365	=C14+D14	=E14*Inputs!$B$8
15	12	=A15/365	=I14	=One_Two/365	=C15+D15	=E15*Inputs!$B$8
16	13	=A16/365	=I15	=One_Two/365	=C16+D16	=E16*Inputs!$B$8
17	14	=A17/365	=I16	=One_Two/365	=C17+D17	=E17*Inputs!$B$8
18	15	=A18/365	=I17	=One_Two/365	=C18+D18	=E18*Inputs!$B$8
19	16	=A19/365	=I18	=One_Two/365	=C19+D19	=E19*Inputs!$B$8
20	17	=A20/365	=I19	=One_Two/365	=C20+D20	=E20*Inputs!$B$8
21	18	=A21/365	=I20	=One_Two/365	=C21+D21	=E21*Inputs!$B$8
22	19	=A22/365	=I21	=One_Two/365	=C22+D22	=E22*Inputs!$B$8
23	20	=A23/365	=I22	=One_Two/365	=C23+D23	=E23*Inputs!$B$8

	G	H	I	J	K
1					
2					
3	Loss Due to SCR Losses (Ci)	TOTAL Losses (Ci)	FINAL Activity (Ci)	Activity (Ci/liter)	Activity (pCi/liter)
4	=E4*Inputs!$B$18	=SUM(F4:G4)	=E4-H4	=I4/Inputs!$F$6	=J4*1000000000000
5	=E5*Inputs!$B$18	=SUM(F5:G5)	=E5-H5	=I5/Inputs!$F$6	=J5*1000000000000
6	=E6*Inputs!$B$18	=SUM(F6:G6)	=E6-H6	=I6/Inputs!$F$6	=J6*1000000000000
7	=E7*Inputs!$B$18	=SUM(F7:G7)	=E7-H7	=I7/Inputs!$F$6	=J7*1000000000000
8	=E8*Inputs!$B$18	=SUM(F8:G8)	=E8-H8	=I8/Inputs!$F$6	=J8*1000000000000
9	=E9*Inputs!$B$18	=SUM(F9:G9)	=E9-H9	=I9/Inputs!$F$6	=J9*1000000000000
10	=E10*Inputs!$B$18	=SUM(F10:G10)	=E10-H10	=I10/Inputs!$F$6	=J10*1000000000000
11	=E11*Inputs!$B$18	=SUM(F11:G11)	=E11-H11	=I11/Inputs!$F$6	=J11*1000000000000
12	=E12*Inputs!$B$18	=SUM(F12:G12)	=E12-H12	=I12/Inputs!$F$6	=J12*1000000000000
13	=E13*Inputs!$B$18	=SUM(F13:G13)	=E13-H13	=I13/Inputs!$F$6	=J13*1000000000000
14	=E14*Inputs!$B$18	=SUM(F14:G14)	=E14-H14	=I14/Inputs!$F$6	=J14*1000000000000
15	=E15*Inputs!$B$18	=SUM(F15:G15)	=E15-H15	=I15/Inputs!$F$6	=J15*1000000000000
16	=E16*Inputs!$B$18	=SUM(F16:G16)	=E16-H16	=I16/Inputs!$F$6	=J16*1000000000000
17	=E17*Inputs!$B$18	=SUM(F17:G17)	=E17-H17	=I17/Inputs!$F$6	=J17*1000000000000
18	=E18*Inputs!$B$18	=SUM(F18:G18)	=E18-H18	=I18/Inputs!$F$6	=J18*1000000000000
19	=E19*Inputs!$B$18	=SUM(F19:G19)	=E19-H19	=I19/Inputs!$F$6	=J19*1000000000000
20	=E20*Inputs!$B$18	=SUM(F20:G20)	=E20-H20	=I20/Inputs!$F$6	=J20*1000000000000
21	=E21*Inputs!$B$18	=SUM(F21:G21)	=E21-H21	=I21/Inputs!$F$6	=J21*1000000000000
22	=E22*Inputs!$B$18	=SUM(F22:G22)	=E22-H22	=I22/Inputs!$F$6	=J22*1000000000000
23	=E23*Inputs!$B$18	=SUM(F23:G23)	=E23-H23	=I23/Inputs!$F$6	=J23*1000000000000