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1 February 2012

Subject: 2011 Annual Operating Report for the Kansas State University TRIGA Mark II Nuclear Reactor (Facility License # R-88, Facility Docket # 50-188)

To Whom It May Concern:

This document serves as the annual operating report for the Kansas State University (KSU) nuclear reactor. This document satisfies requirements in facility Technical Specifications (TS) 6.11.e.

The report is divided into paragraphs addressing specific items listed as requirements in the Technical Specifications.

Sincerely,

Jeffrey A. Geuther, Ph.D.
Nuclear Reactor Facility Manager
Kansas State University

Attachments:

1. Kansas State University TRIGA Mark II Reactor Annual Report, CY 2011
2. 10CFR50.59 Screening Forms

Cc: Spyros Traiforos, Project Manager, NRC

A020
NRR

Kansas State University TRIGA Mark II Reactor Annual Report, CY 2011

Introduction

The Kansas State University Nuclear Reactor Technical Specifications (TS) require a routine written report to be transmitted to the US Nuclear Regulatory Commission within 60 days after completion of the first calendar year of operating, and at intervals not to exceed twelve months thereafter, providing the following information:

TS.6.11.e.1 - A brief narrative summary of operating experience (including experiments performed), changes in facility design, performance characteristics, and operating procedures related to reactor safety occurring during the reporting period; and results of surveillance tests and inspections.

TS.6.11.e.2 - A tabulation showing the energy generated by the reactor (in megawatt-hours).

TS.6.11.e.3 - The number of emergency shutdowns and inadvertent scrams, including the reason thereof and corrective action, if any, taken.

TS.6.11.e.4 - Discussion of the major maintenance operations performed during the period, including the effects, if any, on the safe operation of the reactor, and the reasons for any corrective maintenance required.

TS.6.11.e.5 - A summary of each change to the facility or procedures, tests, and experiments carried out under the conditions of 10.CFR.50.59.

TS.6.11.e.6 - A summary of the nature and amount of radioactive effluents released or discharged to the environs beyond the effective control of the licensee as measured at or before the point of such release or discharge.

TS.6.11.e.7 - A description of any environmental surveys performed outside the facility.

TS.6.11.e.8 - A summary of radiation exposures received by facility personnel and visitors, including the dates and time of significant exposure, and a brief summary of the results of radiation and contamination surveys performed within the facilty.

This information is transmitted in this report, in sections separated by TS clause. This report covers January 2011 – December 2011.

TS.6.11.e.1 - A brief narrative summary of operating experience (including experiments performed), changes in facility design, performance characteristics, and operating procedures related to reactor safety occurring during the reporting period; and results of surveillance tests and inspections.

Calendar year 2011 (CY2011) was a year that highlighted the success of the recovery efforts following a personnel exposure incident on 9/22/10. (For reference see the NRC Special Inspection Report 50-188/2010-202). In particular, the dose to personnel was kept very low in 2011 versus 2010. This statement would be true even if the exposure incident on 9/22/10 was removed from the dose tally. For example, on 6/30/10, prior to the exposure incident, the total year-to-date dose to the staff was 442 person-mrem DDE, versus 81 person-mrem DDE one year later on 6/30/11. Therefore the procedural changes that were made to correct the deficiencies noted in the Special Inspection Report were very successful not only in preventing recurrence of an unanticipated exposure, but in improving overall radiation safety at the facility.

On 6/24/11, an Unusual Event was declared due to an air monitoring system alarm for high radioiodine. The alarm was suspected to be false alarm, but due to disagreement between several channels of secondary indication and uncertainty as to whether there really was high radioiodine, an Unusual Event was declared an hour after the alarm as a matter of conservatism while efforts continued to verify the alarm. Ultimately, it was determined that the alarm was due to miscalibration of the instrument, which had been calibrated earlier in the day. Therefore, there was no fuel damage or release of radioactive materials.

The operations of the facility during CY2011 were normal, with many hours of class support, tours, and training, and research support primarily related to semiconductor neutron detectors. There were no new experiments.

The NRC routine annual inspection during the summer of 2011 yielded no findings.

TS.6.11.e.2 - A tabulation showing the energy generated by the reactor (in megawatt-hours).

The monthly total energy generated by the KSU reactor is recorded in Table 1. The same data is shown as a bar chart in Figure 1. The total MWh of operation was virtually unchanged from the prior year, increasing from 56 MWh to 57 MWh.

Table 1 - Energy generated by the KSU Triga Mark II reactor by month for CY 2011.

Month	MWh
January	1.56
February	5.31
March	6.67
April	8.08
May	3.17
June	3.07
July	1.60
August	6.12
September	1.40
October	12.29
November	5.28
December	2.83

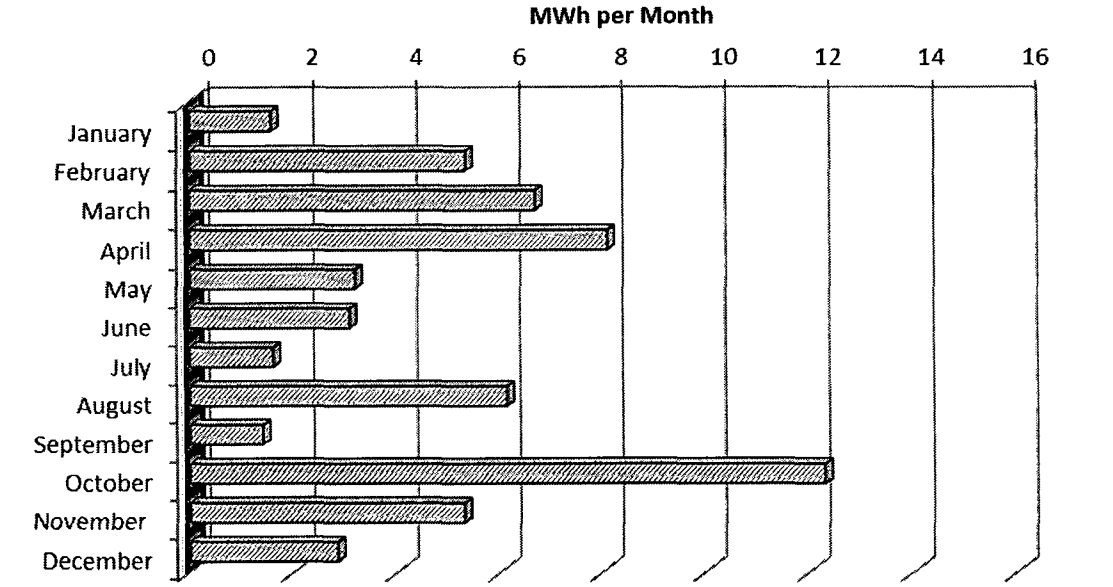

Figure 1 - Energy generated by the KSU Triga Mark II reactor by month for CY 2010.

Figure 2 shows the percentage of hours of reactor operation for various purposes, i.e., research support, training, education, etc. The percentage of hours for training appears small, because operator training was often performed when the reactor was being operated for another purpose, such as research support. The plot demonstrates that the reactor is operated in accordance with our stated primary functions: education; research support (e.g., irradiation); operator training; and demonstration (e.g., tours).

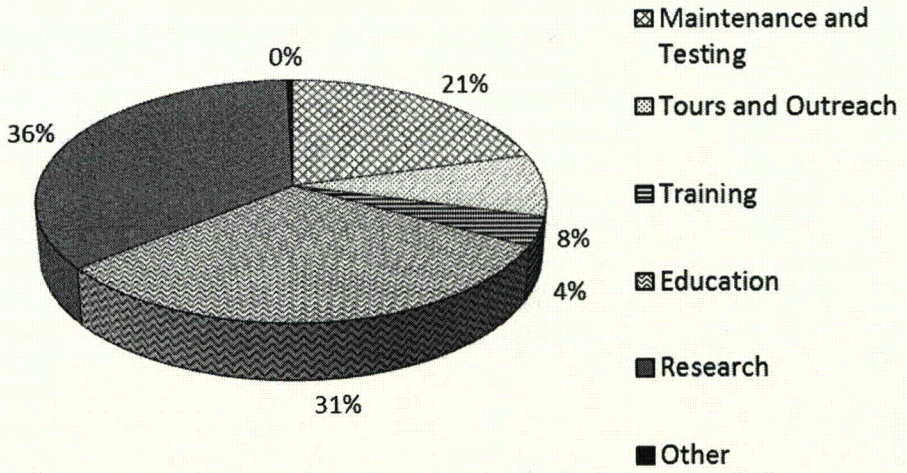

Figure 2 - KSU reactor hours, based on purpose of operation.

TS.6.11.e.3 - The number of emergency shutdowns and inadvertent scrams, including the reason thereof and corrective action, if any, taken.

Inadvertent SCRAMS and Emergency Shutdowns

Date	Action	Comments
1/12/11	Linear power scram	Operator error – RO attempted to downrange NMP-1000, causing scram at low power
4/22/11	Period scram	Operator error
4/30/11	Period scram	Operator error
5/23/11	Period scram	Operator did not set pulse interlock prior to switching to PULSE mode.
5/24/11	HV / percent power scram	Operator selected "Test" instead of "Reset" when resetting instrument
5/24/11	Linear power scram	Unknown cause
6/24/11	AMS alarm	False indication of failed fuel (iodine)
8/16/11	Period scram	Operator error
9/13/11	Linear power scram	Operator error – channel locked into low range

As a result of the AMS alarm on 6/24/11, the AMS detector head that alarmed high was sent out for recalibration. The technician who calibrated the instrument reported that two chips were loose, which may have caused the unusual reading that lead to the false alarm. The neutron activation analysis laboratory was also checked to identify the source of a Cs-137 peak, which seemed to corroborate the AMS iodine alarm, but was ultimately determined to be part of the background spectrum. The source of the Cs-137 was not identified.

TS.6.11.e.4 - Discussion of the major maintenance operations performed during the period, including the effects, if any, on the safe operation of the reactor, and the reasons for any corrective maintenance required.

Two large electrical projects took place during 2011. The first was the installation of an emergency diesel generator. The generator installation provides backup power to some reactor systems, but does not replace any existing backup power source, so it does not adversely affect safety in any way.

The second project is the upgrade to the building power supply, including the installation of new breakers and a transformer in Room 14 of Ward Hall (adjacent to the 0' level of the reactor bay). This project has not yet affected reactor operations in any way, although in early 2012 the reactor AC power will be switched to the new system.

TS.6.11.e.5 - A summary of each change to the facility or procedures, tests, and experiments carried out under the conditions of 10CFR-50.59.

The following changes were carried out under 10CFR-50.59.

- Locked gate added to perimeter fence
- Dosimetry guidance added to Procedure OP-19
- Radiation safety guidance added to Procedure OP-26
- Breaker lockout requirement added to Management Order SOS-3, Cooling Tower Maintenance.
- Emergency diesel generator added as backup AC power source for security system.

None of the above changes were determined to have a significant impact on the safety analysis. Copies of the 10CFR-50.59 screening checklists that were performed to accept the changes are attached to this report.

TS.6.11.e.6 - A summary of the nature and amount of radioactive effluents released or discharged to the environs beyond the effective control of the licensee as measured at or before the point of such release or discharge.

On three occasions, the contents of the sump were discharged to the secondary cooling loop. Per procedure, the radioisotope inventory and concentration were calculated prior to discharge, showing both to be well below the limits in 10CFR-20:

Isotope	Avg. Concentration (µCi / mL)	Limit* (µCi / mL)	Total Volume (mL)	Total Activity Released (µCi)
^{3}H	1.23E-05	1.00E-02	1.06E+07	1.31E+02
^{14}C	7.15E-06	3.00E-04		7.59E+01
^{32}P	4.59E-06	9.00E-05		4.88E+01

*10CFR-20, App.B

The only other discharges beyond the facility boundary were HVAC condensate discharges to the sanitary sewer. Since the Kansas State University average water usage is 750,000 gallons per day, it is nearly impossible to exceed 10CFR20 limits for effluent concentration at the KSU reactor. The HVAC condensate measured concentration levels were all approximately at background levels, which is expected, since the HVAC condensate water is never circulated through or near the reactor core.

TS.6.11.e.7 - A description of any environmental surveys performed outside the facility.

Monthly radiation surveys are performed within the facility to verify that radiation levels remain safe when at full-power operation. These surveys indicate that the dose rate at the inside surface of the reactor dome does not exceed the hourly dose limit to members of the public of 2 mR / h, as set forth in 10CFR-20, which indicates that the outside dose cannot exceed this limit.

TS.6.11.e.8 - A summary of radiation exposures received by facility personnel and visitors, including the dates and time of significant exposure, and a brief summary of the results of radiation and contamination surveys performed within the facilty.

Following an exposure incident on 9/22/10, the reactor procedures were reviewed and revised where necessary to strengthen the radiation protection posture of the facility. This action has resulted in an observed five-fold decrease in both the maximum dose received by an individual and the total person-rem of dose to the reactor staff. The highest annual dose received by any worker in 2011 was 51 mrem DDE. This does not include records from the month of December, which are not yet available. Last year, the highest dose for any worker was 223 mrem. The total person-rem of dose to the reactor staff during the 11 month period from from 1/01/11 to 11/30/11was 158 mrem, compared to 764 mrem from 1/01/10 to 11/30/10. A table showing the number of workers receiving given amounts of dose is presented below.

Table 2 - Summary of total occupational dose received by KSU reactor workers from 12/01/2010 - 11/30/2011. Only workers with more than three months of employment are included.

mrem	DDE	LDE	SDE
(0, 50]	9	9	7
(50, 100]	1	1	3
(100, 150]	0	0	0
(150, 200]	0	0	0
(200, 250]	0	0	0
>250	0	0	0

Visitor dose at the KSU TRIGA reactor facility is measured using Civil Defense self-indicating pocket dosimeters, with an indication range from 0-200 mR. Self-indicated pocket dosimeter readings suffer from imprecision due to parallax error, sometimes resulting in negative values or readings above the true value. In 2011, several dosimeters readings were incorrectly entered into the record systems, such that the dosimeter

exposure reading and dosimeter ID number were reversed. Aberrant results were checked against visitor dose records from the same tour, and were not included in these data if it appeared that the unusual values were from improper data entry or a dropped dosimeter.

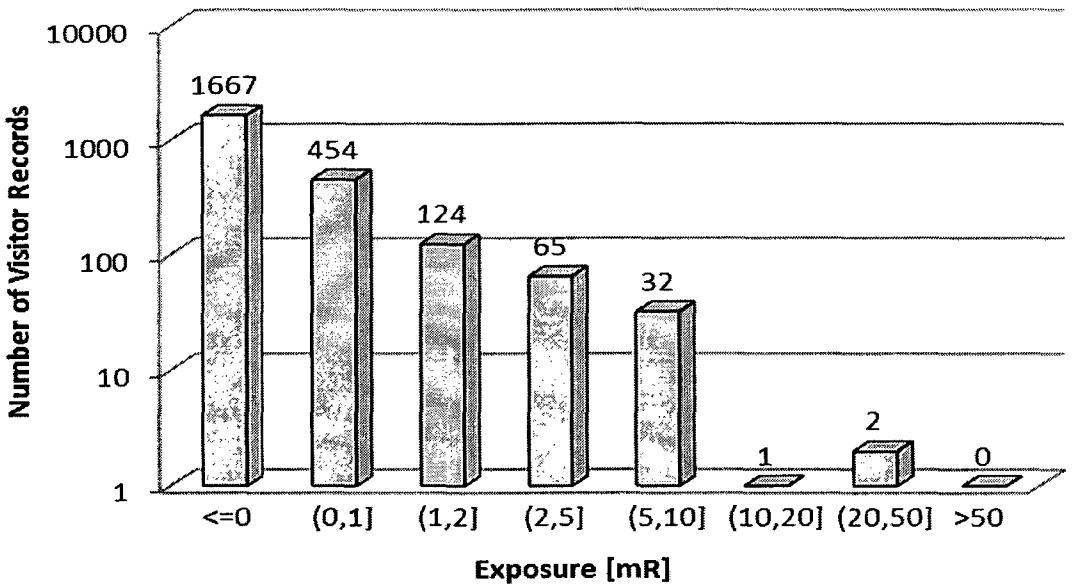

Figure 3 - Visitor dose records from CY 2011. 5 abnormal records removed after checking against other records from the same visit.

All radiation surveys and contamination surveys conducted at the facility in 2010 were nominal.

This concludes the 2011 Annual Report for the Kansas State University TRIGA Mark II Nuclear Reactor.

TITLE	*Experiment Procedure 1*	DATE	1/19/2011
DESCRIPTION	Add locked gate to east side of security fence to allow generator Installation – reactor staff to maintain key control.		

SCREENING: The following guidance provides criteria to screen the proposed change from further assessing need for NRC review. If the change does not affect (1) a design function of SSC, (2) a method of performing or controlling design function, (3) evaluation for demonstrating the design function will be accomplished, then it is not necessary to continue the evaluation.

SSC Affected	SSC Design function	Failure Mode(s)	Accident scenario(s)
NA	NA	NA	NA

SAFETY ANALYSIS & ACCIDENT RESPONSE/MITIGATION	YES	NO
Decrease SSC design function reliability when failure would initiate an accident		X
Decrease SSC design function reliability when failure would mitigate accident		X
Reduce redundancy, reliability or defense in depth		X
Add or delete an automatic or manual design function of an SSC		X

HUMAN INTERFACE	YES	NO
Convert an automatic feature to manual or vice versa		X
Adversely affect ability to perform required actions		X
Adversely affect time response of required actions		X

INTERFACE OUTSIDE THE PROPOSED CHANGE	YES	NO
Degrade seismic or environmental qualification		X
Affect method of evaluation used to establish design basis or safety analysis		X
Introduce an unwanted or previously unreveiwed system or material interaction		X
(Not described in SAR) indirect effects on electrical distribution		X
(Not described in SAR) indirect effects structural integrity		X
(Not described in SAR) indirect effects on environmental conditions		X
(Not described in SAR) indirect effects on other SAR design functions		X

COMMENTS: Effect on facility security is negligible since gate will remain locked and reactor staff will maintain key control. The minimum distance that a member of the public could get to the reactor during an accident scenario will remain the same, so the SAR analyses are all still valid.

PERFORMED BY: J A Geuther DATE: 1/19/2011

If any of the above answers are YES, then proceed to the EVALUATION section.

TITLE	*Operating Procedure 19*	DATE	5/24/11
DESCRIPTION	Add dosimetry guidance to OP-19		

SCREENING: The following guidance provides criteria to screen the proposed change from further assessing need for NRC review. If the change does not affect (1) a design function of SSC, (2) a method of performing or controlling design function, (3) evaluation for demonstrating the design function will be accomplished, then it is not necessary to continue the evaluation.

SSC Affected	SSC Design function	Failure Mode(s)	Accident scenario(s)
NA	NA	NA	NA

SAFETY ANALYSIS & ACCIDENT RESPONSE/MITIGATION	YES	NO
Decrease SSC design function reliability when failure would initiate an accident		X
Decrease SSC design function reliability when failure would mitigate accident		X
Reduce redundancy, reliability or defense in depth		X
Add or delete an automatic or manual design function of an SSC		X

HUMAN INTERFACE	YES	NO
Convert an automatic feature to manual or vice versa		X
Adversely affect ability to perform required actions		X
Adversely affect time response of required actions		X

INTERFACE OUTSIDE THE PROPOSED CHANGE	YES	NO
Degrade seismic or environmental qualification		X
Affect method of evaluation used to establish design basis or safety analysis		X
Introduce an unwanted or previously unreveiwed system or material interaction		X
(Not described in SAR) indirect effects on electrical distribution		X
(Not described in SAR) indirect effects structural integrity		X
(Not described in SAR) indirect effects on environmental conditions		X
(Not described in SAR) indirect effects on other SAR design functions		X

COMMENTS:

PERFORMED BY: J A Geuther DATE: 05/24/11

If any of the above answers are YES, then proceed to the EVALUATION section.

TITLE	*Operating Procedure 26*	DATE	5/10/11
DESCRIPTION	Add radiation safety guidance to OP26		

SCREENING: The following guidance provides criteria to screen the proposed change from further assessing need for NRC review. If the change does not affect (1) a design function of SSC, (2) a method of performing or controlling design function, (3) evaluation for demonstrating the design function will be accomplished, then it is not necessary to continue the evaluation.

SSC Affected	SSC Design function	Failure Mode(s)	Accident scenario(s)
NA	NA	NA	NA

SAFETY ANALYSIS & ACCIDENT RESPONSE/MITIGATION	YES	NO
Decrease SSC design function reliability when failure would initiate an accident		X
Decrease SSC design function reliability when failure would mitigate accident		X
Reduce redundancy, reliability or defense in depth		X
Add or delete an automatic or manual design function of an SSC		X

HUMAN INTERFACE	YES	NO
Convert an automatic feature to manual or vice versa		X
Adversely affect ability to perform required actions		X
Adversely affect time response of required actions		X

INTERFACE OUTSIDE THE PROPOSED CHANGE	YES	NO
Degrade seismic or environmental qualification		X
Affect method of evaluation used to establish design basis or safety analysis		X
Introduce an unwanted or previously unreveiwed system or material interaction		X
(Not described in SAR) indirect effects on electrical distribution		X
(Not described in SAR) indirect effects structural integrity		X
(Not described in SAR) indirect effects on environmental conditions		X
(Not described in SAR) indirect effects on other SAR design functions		X

COMMENTS:

PERFORMED BY: J A Geuther DATE: 05/10/11

If any of the above answers are YES, then proceed to the EVALUATION section.

TITLE	*SOS-3, Cooling tower maintenance*	DATE	02/10/2011
DESCRIPTION	Include orders to lock out breaker prior to checking belt tension		

SCREENING: The following guidance provides criteria to screen the proposed change from further assessing need for NRC review. If the change does not affect (1) a design function of SSC, (2) a method of performing or controlling design function, (3) evaluation for demonstrating the design function will be accomplished, then it is not necessary to continue the evaluation.

SSC Affected	SSC Design function	Failure Mode(s)	Accident scenario(s)
NA	NA	NA	NA

SAFETY ANALYSIS & ACCIDENT RESPONSE/MITIGATION	YES	NO
Decrease SSC design function reliability when failure would initiate an accident		X
Decrease SSC design function reliability when failure would mitigate accident		X
Reduce redundancy, reliability or defense in depth		X
Add or delete an automatic or manual design function of an SSC		X

HUMAN INTERFACE	YES	NO
Convert an automatic feature to manual or vice versa		X
Adversely affect ability to perform required actions		X
Adversely affect time response of required actions		X

INTERFACE OUTSIDE THE PROPOSED CHANGE	YES	NO
Degrade seismic or environmental qualification		X
Affect method of evaluation used to establish design basis or safety analysis		X
Introduce an unwanted or previously unreveiwed system or material interaction		X
(Not described in SAR) indirect effects on electrical distribution		X
(Not described in SAR) indirect effects structural integrity		X
(Not described in SAR) indirect effects on environmental conditions		X
(Not described in SAR) indirect effects on other SAR design functions		X

COMMENTS:

PERFORMED BY: J A Geuther DATE: 02/10/2011

If any of the above answers are YES, then proceed to the EVALUATION section.

TITLE	*Diesel Generator*	DATE	10/1/11
DESCRIPTION	Add a diesel generator as a backup power source for the security system.		

SCREENING: The following guidance provides criteria to screen the proposed change from further assessing need for NRC review. If the change does not affect (1) a design function of SSC, (2) a method of performing or controlling design function, (3) evaluation for demonstrating the design function will be accomplished, then it is not necessary to continue the evaluation.

SSC Affected	SSC Design function	Failure Mode(s)	Accident scenario(s)
NA	NA	NA	NA

SAFETY ANALYSIS & ACCIDENT RESPONSE/MITIGATION	YES	NO
Decrease SSC design function reliability when failure would initiate an accident		X
Decrease SSC design function reliability when failure would mitigate accident		X
Reduce redundancy, reliability or defense in depth		X
Add or delete an automatic or manual design function of an SSC		X

HUMAN INTERFACE	YES	NO
Convert an automatic feature to manual or vice versa		X
Adversely affect ability to perform required actions		X
Adversely affect time response of required actions		X

INTERFACE OUTSIDE THE PROPOSED CHANGE	YES	NO
Degrade seismic or environmental qualification		X
Affect method of evaluation used to establish design basis or safety analysis		X
Introduce an unwanted or previously unreveiwed system or material interaction		X
(Not described in SAR) indirect effects on electrical distribution	X	
(Not described in SAR) indirect effects structural integrity		X
(Not described in SAR) indirect effects on environmental conditions		X
(Not described in SAR) indirect effects on other SAR design functions		X

COMMENTS:

PERFORMED BY: J A Geuther DATE: 10/1/11

If any of the above answers are YES, then proceed to the EVALUATION section.

Evaluation – The diesel generator provides backup power to the security system following loss of onsite power. The addition of the generator does not reduce or inhibit availability of existing sources of backup power to the system, and therefore does not reduce system effectiveness.