Wolf Creek
Nuclear Operating Corporation

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Vice President Engineering

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ET 22-0010

U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555-0001

Subject: Docket No. 50-482: License Amendment Request (LAR) for Deviation from Fire Protection Program Requirements

Commissioners and Staff:

Pursuant to 10 CFR 50.90, Wolf Creek Nuclear Operating Corporation (WCNOC) hereby requests an amendment to the Renewed Facility Operating License No. NPF-42 for the Wolf Creek Generating Station (WCGS). This license amendment request is seeking approval by the Commission, pursuant to License Condition 2.C(5), to make changes to the approved fire protection program as described in the Updated Safety Analysis Report (USAR). Specifically, a deviation from USAR Appendix 9.5E "10 CFR Part 50 Appendix R Comparison," allowing the use of portable lighting as the primary emergency lighting means (with limited exceptions) for illuminating safe shutdown equipment and access egress routes to the equipment.

Attachment I provides the evaluation and justification for the proposed license amendment. Attachment II provides the markup of the Renewed Facility Operating License. Attachment III provides the markup of USAR Appendix 9.5E. USAR Appendix 9.5E provides a design comparison to 10 CFR 50 Appendix R. Enclosure I provides a revision to document E-1F9900, "Post-Fire Safe Shutdown Operator Manual Actions," which is identified by interim document number WIP-E-1F9900-010-A-1. Document WIP-E-1F9900-010-A-1 will be released as a new revision to document E-1F9900 based on approval of this license amendment request. Document E-1F9900 is incorporated by reference in USAR Appendix 9.5B.

It has been determined that this amendment application does not involve a significant hazard consideration as determined per 10 CFR 50.92. The amendment application was reviewed by the WCNOC Plant Safety Review Committee. In accordance with 10 CFR 50.91, a copy of this application is being provided to the designated Kansas State official.

WCNOC requests approval of this proposed amendment a year following acceptance. Once approved, the amendment will be implemented within 90 days of receipt.

If you have any questions concerning this matter, please contact me at (620) 364-8831 x8687, or Ron Benham at (620) 364-4204.

Sincerely,

Michael T. Boyce

MTB/

Attachments: I - Evaluation of Proposed Change
II - Markup of the Renewed Facility Operating License
III - Markup of USAR Pages

Enclosures: I - Document WIP-E-1F9900-010-A-1, "Post-Fire Safe Shutdown Operator Manual Actions"

cc: S. S. Lee (NRC), w/a, w/e
S. A. Morris, (NRC), w/a, w/e
K. S. Steves (KDHE), w/a, w/e
G. E. Werner (NRC), w/a, w/e
Senior Resident Inspector (NRC), w/a, w/e

STATE OF KANSAS)
) SS
COUNTY OF COFFEY)

Michael T. Boyce, of lawful age, being first duly sworn upon oath says that he is Vice President Engineering of Wolf Creek Nuclear Operating Corporation; that he has read the foregoing document and knows the contents thereof; that he has executed the same for and on behalf of said Corporation with full power and authority to do so; and that the facts therein stated are true and correct to the best of his knowledge, information and belief.

By MTBoyce
Michael T. Boyce
Vice President Engineering

SUBSCRIBED and sworn to before me this 2nd day of August, 2022.

GAYLE SHEPHEARD
My Appointment Expires
July 24, 2023

Gayle Shepheard
Notary Public

Expiration Date 7/24/2023

EVALUATION OF PROPOSED CHANGE

Subject: License Amendment Request for Deviation from Fire Protection Program Requirements

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1. SUMMARY DESCRIPTION

The proposed amendment would revise the Renewed Facility Operating License to deviate from a Wolf Creek Generating Station (WCGS) Fire Protection Program Requirement. The proposed amendment credits the use of portable lighting in certain applications as the primary emergency lighting means for illuminating implementing procedures, safe shutdown equipment, and the respective access egress routes to the equipment in support of post-fire safe shutdown or a non-fire event resulting in the loss of all AC power. The proposed amendment would replace the requirement of meeting the 8-hour fixed emergency lighting requirements of 10 CFR 50 Appendix R, Section III.J referenced in Appendix 9.5E, "10 CFR Part 50 Appendix R Comparison," of the WCGS Updated Safety Analysis Report (USAR).

2. DETAILED DESCRIPTION

The proposed changes would revise Paragraph 2.C.(5)(a) of the renewed facility operating license and the fire protection program as described in the USAR.

License Condition 2.C.(5)(a) currently states:

> (a) The Operating Corporation shall maintain in effect all provisions of the approved fire protection program as described in the SNUPPS Final Safety Analysis Report for the facility through Revision 17, the Wolf Creek site addendum through Revision 15, as approved in the SER through Supplement 5, Amendment No. 189, Amendment No. 191, Amendment No. 193, Amendment No. 205, and Amendment No. 214, subject to provisions b and c below.

License Condition 2.C.(5)(a) is revised to state:

> (a) The Operating Corporation shall maintain in effect all provisions of the approved fire protection program as described in the SNUPPS Final Safety Analysis Report for the facility through Revision 17, the Wolf Creek site addendum through Revision 15, as approved in the SER through Supplement 5, Amendment No. 189, Amendment No. 191, Amendment No. 193, Amendment No. 205, Amendment No. 214, and Amendment No. XXX, subject to provisions b and c below.

The proposed change reflects the approved fire protection program based on the issuance of the license amendment approving the proposed change. The amendment number will be reflected in the license condition upon the issuance of the amendment.

The proposed changes would revise USAR Table 9.5E-1 (Sheet 19) and Sections 9.5.3.1.2, 9.5.3.2.3, and 9.5.3.3. The specific changes to the USAR are shown in Attachment III.

The WCGS Fire Protection Program is described in USAR Section 9.5.1 and Appendices 9.5A through 9.5E. Historically, Appendix 9.5B provided the Fire Hazards Analysis. The Fire Hazard Analysis is now located in document E-1F9905. Appendix 9.5B of the USAR incorporates by reference the following documents:

- E-1F9905, "Fire Hazard Analysis"
- E-1F9900, "Post-Fire Safe Shutdown Manual Actions"

- E-1F9910, "Post-Fire Safe Shutdown Fire Area Analysis"
- E-1F9915, "Design Basis Document for OFN RP-017, Control Room Evacuation"
- XX-E-013, "Post-Fire Safe Shutdown (PFSSD) Analysis"
- M-663-00017A, "Fire Protection Evaluations for Unique or Unbounded Fire Barrier Configurations"

USAR Appendix 9.5E provides a design comparison to 10 CFR 50 Appendix R and how WCGS compares with the specific requirements of 10 CFR 50 Appendix R. Specifically, Section III.J of 10 CFR 50 Appendix R states the following: "Emergency lighting units with at least an 8-hour battery power supply shall be provided in all areas needed for operation of safe shutdown equipment and in access and egress routes thereto." WCGS's response to the requirement was: "The Power block Complies. As stated in Section 9.5.3.2.3, emergency lighting units with eight-hour batteries are located in all plant areas required for operation of safe shutdown equipment and also those areas necessary for access and egress. The ESW pumphouse also complies."

Historically, Wolf Creek Nuclear Operating Corporation (WCNOC) has credited fixed emergency lighting with 8-hour battery capacity as the means for illuminating safe shutdown equipment and access and egress paths to the safe shutdown equipment. This was driven by the USAR Appendix 9.5E comparison response to 10 CFR 50 Appendix R, Section III.J discussed above. WCNOC continues to maintain a deterministic fire protection license basis, with no plan to transition the fire protection program to a National Fire Protection Association (NFPA) 805, "Performance-Based Standard for Fire Protection for Light Water Reactor Electric Generating Plants," (Reference 1) risk informed license basis. However, WCNOC desires to utilize the flexibility from NFPA 805 to provide adequate lighting for illuminating safe shutdown equipment, as NFPA 805 does not define the type of emergency lighting required. Specifically, WCNOC seeks to utilize portable lighting, with limited exception, as the primary emergency lighting means for the illumination of implementing procedures, safe shutdown equipment, and the respective access and egress routes to the equipment in support of post-fire safe shutdown or a non-fire event resulting in the loss of all AC power. The NFPA 805 deterministic evaluation approach utilized for the portable emergency lighting strategy is comparable to that conducted within the evaluation contained in Enclosure I. The relevant sections from NFPA 805 from which this request stems are provided below:

- NFPA 805 Section 1.5.3(2), Provide adequate protection, including emergency lighting, for essential personnel to perform necessary safety functions as a result of a fire event.

- NFPA 805 Section B.5.2(3), The lighting should be evaluated to ensure sufficient lighting is available to perform the intended action.

With limited exception, portable lighting will be the primary illumination means for implementing procedures, safe shutdown equipment, and the respective access egress routes to the equipment in support of post-fire shutdown or a non-fire event resulting in the loss of all AC power. This encompasses the following WCGS procedure scope:

- OFN RP-017, "Control Room Evacuation"
- OFN KC-016, "Fire Response"
- EMG C-0, "Loss of All AC Power"

- OFN NB-034, "Loss of All AC Power – Shutdown Conditions"

With the integration of portable lighting into the emergency lighting strategy, the following diverse approach will be utilized:

- 8-hour fixed battery units for the locations that may require long term attendance in support of safe shutdown. These locations are identified in Enclosure 1, Table E.2.5-1 of WIP-E-1F9900-010-A-1.

- Portable (hard hat mounted) lighting for illuminating implementing procedures, safe shutdown equipment, and the access and egress routes to the equipment. This will be the primary emergency lighting method for most locations.

- 1.5 hour fixed battery units for firefighting activities, life safety access and egress, and supplementary lighting to portable lighting.

WCNOC requests approval pursuant to License Condition 2.C(5) to deviate from the 10 CFR 50 Appendix R comparison response referenced in USAR Appendix 9.5E, allowing the use of portable lighting as the primary emergency lighting means (with limited exceptions) for illuminating safe shutdown equipment and access and egress routes to the equipment. The applicable changes to License Condition 2.C(5) and the USAR (i.e., markup of proposed changes) are contained in Attachment II and III respectively.

3. TECHNICAL EVALUATION

As discussed in Section 2 above, document E-1F9900, "Post-Fire Safe Shutdown Manual Actions," is incorporated by reference into USAR Appendix 9.5B. Attachment E to document E-1F9900 was developed to provide the technical bases for crediting portable lighting as the primary means for illuminating implementing procedures, safe shutdown equipment and access and egress routes to the equipment. This evaluation is captured in interim document number WIP-E-1F9900-010-A-1 and is provided in Enclosure I. The proposed USAR changes supporting the document WIP-E-1F9900-010-A-1 evaluation are provided in Attachment III. Major elements of the evaluation are as follows:

- Fixed emergency lighting that will continue to be credited for an 8-hour illumination duration.
- Portable lighting selected and the requirements for an equivalent replacement.
- Portable lighting illumination test results, including a comparison to 8-hour fixed emergency lighting.
- Strategy for ensuring portable lighting functionality for on shift personnel with operator manual action (OMA) responsibility.
- Strategic placement and inventory of spare portable lighting equipment.
- Defense-In-Depth review.
- Feasibility and Reliability analysis.

The document WIP-E-1F9900-010-A-1 evaluation concluded that considering the superior illumination levels provided by the portable lighting in comparison to the fixed emergency lighting, the procedure implementation duration for OMAs, the battery life of the portable lighting, the strategy for ensuring battery charge level at the beginning of a shift, and the strategic location of spare portable lighting equipment in the plant, adequate illumination will be provided by the portable lighting for the performance of OMAs in support of safe shutdown from either a fire or an event resulting in the loss of all AC power. The portable lighting evaluation described in document WIP-E-1F9900-010-A-1 is acceptable as the primary emergency lighting methodology for a diverse emergency lighting strategy that includes the following:

- 8-hour fixed battery units for the locations that may require long term attendance in support of safe shutdown
- Portable (hard hat mounted) lighting for illuminating safe shutdown implementing procedures, equipment, and the access and egress routes to the equipment.
- 1.5-hour fixed battery units for firefighting activities, life safety access and egress, and supplementary lighting to portable lighting.

3.1 Public Meeting Considerations

A public teleconference meeting was held with the Nuclear Regulatory Commission (NRC) on January 10th, 2022 to discuss the portable lighting License Amendment Request (LAR) submittal. The summary of the teleconference is documented in NRC Accession No. ML22011A086. During the teleconference the NRC staff provided comments that should be considered in the LAR development. The NRC comments documented are identified below, followed by the WCNOC response.

Comment #1

Discussion of the feasibility and reliability analysis consistent with guidance in NUREG-1852, "Demonstrating the Feasibility and Reliability of Operator Manual Actions in Response to Fire."

Response

Section E.10 of document WIP-E-1F9900-010-A-1 addresses the feasibility and reliability of operator manual actions considering the use of portable lighting as a primary means for emergency lighting. The change has no adverse impact on the feasibility and reliability of operator manual actions.

Comment #2

Non-applicability of National Fire Protection Association's Standard 805 (NFPA 805) as a precedent because NFPA 805 does not have requirements for emergency lighting, and the feasibility criteria are up to the licensees.

Response

Section E.3 and E.4.6 of document WIP-E-1F9900-010-A-1 discusses NFPA 805 relevance. The 2001 edition of NFPA 805 does require evaluation that sufficient lighting is available to perform the intended action. WCNOC continues to maintain a deterministic fire protection license basis, with no plan to transition the fire protection program to a NFPA 805 risk informed license basis. However, WCNOC does desire to apply the flexibility allowed by NFPA 805 regarding emergency lighting for OMAs. In multiple instances, NFPA 805 plants have successfully evaluated the use of portable lighting as the primary emergency lighting means for the illumination of OMAs. The NFPA 805 evaluation approach utilized for the portable emergency lighting strategy is comparable to that conducted within the document WIP-E-1F9900-010-A-1 evaluation.

Comment #3

Screening out of non-applicable precedent exemptions, such as those related to the general yard areas.

Response

Section E.13 of document WIP-E-1F9900-010-A-1 identifies the instances where the NRC has approved previous requests for alternative emergency lighting approaches (flashlights) in lieu of direct compliance with 10 CFR 50 Appendix R Section III.J. The precedent table in document WIP-E-1F9900-010-A-1 does not include exemptions that are exclusive approval of portable lighting for transiting through outside yard areas.

Comment #4

Discussion of dedication process for headlamps for the proposed application.

Response

Section E.6 of document WIP-E-1F9900-010-A-1 identifies the commercially available portable light selected, including the testing and standard that the equipment is subjected to.

Comment #5

Discussion of batteries and chargers for headlamps.

Response

Section E.6 of document WIP-E-1F9900-010-A-1 discusses the rechargeable battery specifications, and that battery charging will be conducted via a multi-battery charger located in the Work Control Center area across from the Control Room.

4. REGULATORY EVALUATION

4.1 Applicable Regulatory Requirements/Criteria

10 CFR 50, Section 48, Fire protection, which states in paragraph (a) that "Each holder of an operating license issued under this part or a combined license issued under part 52 of this chapter must have a fire protection plan that satisfies Criterion 3 of appendix A to this part." Paragraph (b) states, "Appendix R to this part establishes fire protection features required to satisfy Criterion 3 of appendix A to this part with respect to certain generic issues for nuclear power plants licensed to operate before January 1, 1979."

10 CFR 50, Appendix A, *Criterion 3- Fire protection.* Structures, systems, and components important to safety shall be designed and located to minimize, consistent with other safety requirements, the probability and effect of fires and explosions. Noncombustible and heat resistant materials shall be used wherever practical throughout the unit, particularly in locations such as the containment and control room. Fire detection and fighting systems of appropriate capacity and capability shall be provided and designed to minimize the adverse effects of fires on structures, systems, and components important to safety. Firefighting systems shall be designed to assure that their rupture or inadvertent operation does not significantly impair the safety capability of these structures, systems, and components.

10 CFR 50, Appendix R, "Fire Protection Program for Nuclear Power Facilities Operating Prior to January 1, 1979," Section III.J, *Emergency lighting.* "Emergency lighting units with at least an 8-hour battery power supply shall be provided in all areas needed for operation of safe shutdown equipment and in access and egress routes thereto."

Since WCGS was licensed after January 1, 1979, WCGS is not obligated to meet the requirements of Section III.J. However, USAR Appendix 9.5E provides a comparison of the WCGS design to Appendix R. The use of portable lighting in lieu of fixed 8-hour emergency lighting proposed in this amendment request has not previously been reviewed by the NRC for WCGS.

4.2 Significant Hazards Consideration

The proposed amendment request is requesting Nuclear Regulatory Commission (NRC) approval, pursuant to License Condition 2.C(5), to make changes to the approved fire protection program as described in the Wolf Creek Generating Station (WCGS) Updated Safety Analysis Report (USAR). The proposed amendment credits the use of portable lighting in certain applications as the primary emergency lighting means for illuminating implementing procedures, safe shutdown equipment, and the respective access and egress routes to the equipment in support of post-fire safe shutdown or a non-fire event resulting in the loss of all AC power. The proposed amendment would replace the requirement of meeting the 8-hour fixed emergency lighting requirements of 10 CFR 50 Appendix R, Section III.J referenced in Appendix 9.5E, "10 CFR Part 50 Appendix R Comparison," of the USAR.

Wolf Creek Nuclear Operating Corporation (WCNOC) has evaluated whether or not a significant hazards consideration is involved with the proposed amendment by focusing on the three standards set forth in 10 CFR 50.92, "Issuance of amendment," as discussed below:

1. Does the proposed amendment involve a significant increase in the probability or consequences of an accident previously evaluated?

   Response: No.

   The design function of structures, systems and components (SSCs) are not impacted by the proposed change. The proposed change involves the use of portable lighting in supporting the performance of operator manual actions to achieve and maintain safe shutdown in support of post-fire safe shutdown or a non-fire event resulting in the loss of all AC power. The proposed change does not alter or prevent the ability of SSCs from performing their intended function to mitigate the consequences of an initiating event within the assumed acceptance limits. Equipment required to mitigate an accident remains capable of performing the assumed function.

   An evaluation determined that the post-fire operator manual actions for a fire outside the Control Room continue to remain feasible and reliable demonstrating that the plant can be safely shutdown in the event of a fire. Additionally, the performance of the operator manual actions in support of applicable procedures will not be adversely affected by the use of portable lighting as the primary emergency lighting means. There are no significant consequences resulting from the performance of the proposed change.

   Therefore, the proposed change does not involve a significant increase in the probability or consequences of an accident previously evaluated.

2. Does the proposed amendment create the possibility of a new or different kind of accident from any accident previously evaluated?

   Response: No.

   The proposed change will not alter the requirements or function for systems required during accident conditions. The design function of structures, systems and components are not impacted by the proposed change. The proposed change involves crediting an alternative emergency lighting source for operator manual actions in support of safe shutdown. The use of an alternative emergency lighting source does not involve new failure mechanisms or malfunctions that can initiate a new accident.

   Therefore , the proposed change does not create the possibility of a new or different kind of accident from any accident previously evaluated.

3. Does the proposed amendment involve a significant reduction in a margin of safety?

   Response: No.

   There will be no effect on the manner in which safety limits or limiting safety system settings are determined nor will there be any effect on those plant systems necessary to assure the accomplishment of protection functions. The proposed change provides an alternative approach to fixed emergency lighting for illuminating implementing procedures, safe shutdown equipment, and the respective access and egress routes to the equipment in support of post-fire safe shutdown or a non-fire event resulting in the loss of all AC

power. An evaluation determined that the proposed portable lighting coupled with the strategy for ensuring portable lighting battery life will result in illumination levels commensurate with that provided by fixed emergency lighting.

Therefore, the proposed change does not involve a significant reduction in a margin of safety.

4.3 Conclusions

In conclusion, based on the considerations discussed above, (i) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, (ii) such activities will be conducted in compliance with the Commission's regulations, and (iii) the issuance of the amendment will not be inimical to the common defense and security or to the health and safety of the public.

5. ENVIRONMENTAL CONSIDERATION

WCNOC has determined that the proposed amendment would change a requirement with respect to installation or use of a facility component located within the restricted area, as defined in 10 CFR 20, "Standards for protection against radiation," or would change an inspection or surveillance requirement. However, the proposed amendment does not involve (i) a significant hazards consideration, (ii) a significant change in the types or a significant increase in the amounts of any effluents that may be released offsite, or (iii) a significant increase in individual or cumulative occupational radiation exposure. Accordingly, the proposed amendment meets the eligibility criterion for categorical exclusion set forth in paragraph (c)(9) of 10 CFR 51.22, "Criterion of categorical exclusion, identification of licensing and regulatory actions eligible for categorical exclusion or otherwise not requiring an environmental review." Therefore, pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the proposed amendment.

6. REFERENCES

6.1 NFPA 805, Performance-Based Standard for Fire Protection for Light Water Reactor Electric Generating Plants, 2001 Edition

Markup of Renewed Facility Operating License

(5) Fire Protection (Section 9.5.1, SER, Section 9.5.1.8, SSER #5)

(a) The Operating Corporation shall maintain in effect all provisions of the approved fire protection program as described in the SNUPPS Final Safety Analysis Report for the facility through Revision 17, the Wolf Creek site addendum through Revision 15, as approved in the SER through Supplement 5, Amendment No. 189, Amendment No. 191, Amendment No. 193, Amendment No. 205, ~~and~~ Amendment No. 214, and Amendment No. XXX, subject to provisions b and c below.

and Amendment No. XXX,

(b) The licensee may make changes to the approved fire protection program without prior approval of the Commission only if those changes would not adversely affect the ability to achieve and maintain safe shutdown in the event of a fire.

(c) Deleted.

(6) Qualification of Personnel (Section 13.1.2, SSER #5, Section 18, SSER #1)

Deleted per Amendment No. 141.

(7) NUREG-0737 Supplement 1 Conditions (Section 22, SER)

Deleted per Amendment No. 141.

(8) Post-Fuel-Loading Initial Test Program (Section 14, SER Section 14, SSER #5)

Deleted per Amendment No. 141.

(9) Inservice Inspection Program (Sections 5.2.4 and 6.6, SER)

Deleted per Amendment No. 141.

(10) Emergency Planning

Deleted per Amendment No. 141.

(11) Steam Generator Tube Rupture (Section 15.4.4, SSER #5)

Deleted per Amendment No. 141.

(12) LOCA Reanalysis (Section 15.3.7, SSER #5)

Deleted per Amendment No. 141.

Markup of USAR Pages

WOLF CREEK

TABLE 9.5E-1 (Sheet 19)

10CFR50 Appendix R	WCGS
broadened training for fire fighting within buildings shall be scheduled for all those brigade members whose performance records show deficiencies.	
III. J. Emergency Lighting	
Emergency lighting units with at least an 8-hour battery power supply shall be provided in all areas needed for operation of safe shutdown equipment and in access and egress routes thereto.	~~The Power block Complies. As stated in Section 9.5.3.2.3, emergency lighting units with eight-hour batteries are located in all plant areas required for operation of safe shutdown equipment and also those areas necessary for access and egress.~~ ~~The ESW pumphouse also complies.~~
III. K. Administrative Controls	
Administrative controls shall be established to minimize fire hazards in areas containing structures, systems, and components important to safety. These controls shall establish procedures to: 1. Govern the handling and limitation of the use of ordinary combustible materials, combustible and flammable gases	Administrative procedures define limitations to minimize fire hazards in areas containing SSCs important to safety. Administrative procedures are also provided to promote prompt, appropriate action upon discovery of a fire.

The emergency lighting strategy involves a diverse approach utilizing the following:

- 8-hour fixed battery units for the locations that may require long term attendance in support of safe shutdown. These locations are identified in E-1F9900.

- Portable (hard hat mounted) lighting for illuminating implementing procedures, safe shutdown equipment, and the access egress routes to the equipment. This will be the primary emergency lighting method for most locations.

- 1.5-hour fixed battery units for firefighting activities, life safety access/egress, and supplementary lighting to portable lighting.

Rev. 17

9.5.2.4 Tests and Inspections

Systems of the types described above are conventional and have a history of successful operation at existing plants.

All communication systems are inspected and tested at the completion of installation to ensure proper coverage and audibility. During plant operations, the routine use of the normal communication systems ensures their reliability. Periodic inspection and testing is performed on the backup systems. Where applicable, the radio equipment is checked and calibrated in accordance with Federal Communication Commission guidance.

9.5.3 LIGHTING SYSTEM

The plant lighting systems include normal, standby, and emergency lighting designed to provide adequate lighting during normal operation, accident conditions, a loss of offsite power, and postulated fires including a fire in the control room which requires evacuation of the control room.

9 5.3.1 Design Bases

9.5.3.1.1 Safety Design Bases

The lighting system has no safety design bases.

9.5.3.1.2 Power Generation Design Bases

POWER GENERATION DESIGN BASIS ONE - Adequate lighting ~~systems are~~ provided ~~in~~ areas used during shutdown or emergency, including the appropriate access or exit routes.

fixed and/or portable

is

for

POWER GENERATION DESIGN BASIS TWO - Lighting intensities are designed for those levels recommended by the Illuminating Engineering Society.

POWER GENERATION DESIGN BASIS THREE - Mercury-vapor fixtures are not used inside the containment or directly above the fuel storage pool .

POWER GENERATION DESIGN BASIS FOUR - The main control room is given special attention to reduce glare and shadows at the control boards.

9.5.3.2 System Description

The plant lighting distribution systems are illustrated schematically in Figure 9.5.3-1.

9.5.3.2.1 Normal Lighting System

The normal lighting system consists of a complete distribution network of cables, raceways, transformers, lighting panels, fixtures, receptacles, and switches.

This system is fed from the non-Class IE auxiliary power system and is designed to provide adequate illumination levels for normal plant operating and service conditions. A selected number of normal lighting fixtures are chosen to be used in the standby lighting system.

illumination of panel locations that may require long term attendance in support of safe shutdown.

9.5.3.2.2 Standby Lighting System

The standby lighting system consists of selected fixtures of the normal lighting system in the auxiliary, control, reactor, and turbine buildings. These fixtures are supplied from the emergency diesel generators during the loss of offsite power and are isolated from the Class IE power source on the occurrence of an SI signal. These circuits are treated as non-Class IE, non-associated.

fixed

9.5.3.2.3 Emergency Lighting Systems

The emergency lighting system consists of individual sealed-beam, self-contained battery units to provide ~~silhouette lighting, that is, to provide shadows and to highlight obstructions to personnel for access and egress. Eight-hour battery units are located throughout the plant, including areas requiring operator actions for safe shutdown following a fire~~.

8-hour

~~The locations of emergency lighting fixtures have been selected to provide for access and egress to/from the auxiliary, control, fuel, diesel generator, reactor, and radwaste buildings; the communication corridor; and the ESW pump house. Lighting to and from the radwaste building and the ESW pump house is provided by the site. The emergency lighting provided ensures egress from these areas in the event of a loss of off-site power, a design basis event, or a fire, should the normal lighting and standby lighting (powered by the emergency diesels) be unavailable. All emergency lights credited to meet 10 CFR 50, Appendix R requirements are provided with 8-hour batteries.~~

~~As described in Section 7.4, the WCGS design ensures that there are no preplanned manual operations outside of the control room for maintenance of hot shutdown following a design basis event, a severe natural phenomenon, or a loss of offsite power. The WCGS design also includes provisions to achieve and maintain hot and cold shutdown using safety-related equipment.~~

Portable lighting, via a hard hat mounted headlamp worn by Operations personnel designated for operator manual action response, is credited as the primary emergency lighting means for illuminating implementing procedures, safe shutdown equipment, and the respective access egress routes to the equipment in support of post-fire safe shutdown or a non-fire event resulting in the loss of all AC power. Spare portable lighting and batteries are strategically located in the plant to ensure adequate reserve illumination capability for the portable lighting. Refer to E-1F9900 for the technical basis supporting the use of portable lighting as the primary emergency lighting means for operator manual actions.

For cold shutdown, operator actions may be required in the electrical penetration rooms (1409 and 1410) to isolate the accumulator tanks and to open the RHR suction valves from the hot legs. These actions may be taken as late as 72 hours following an event. The safe shutdown scenario does not require access to the containment for hot shutdown but could require access to containment for cold shutdown.

~~The 8-hour battery-backed emergency lighting fixtures provide lighting for fire fighting activities in the areas listed previously. For fires in the general plant areas, operator actions may be required outside of the control room to maintain hot standby. In the event of a fire, the standby lighting system should remain operable; however, the emergency lighting provides access to the areas and lighting within the areas where operator actions are required. These provisions meet the requirements of 10 CFR 50, Appendix R, Paragraph III.J.~~

In areas required to be manned for safe shutdown, sufficient lighting is directed at the control panels to enable operation of controls. This includes the following:

with 8-hour battery packs

a. Main control board
b. Auxiliary shutdown panel(s)
c. Diesel generator control panel(s)

In the area above the main control board and operator's console, the emergency lighting system consists of emergency lights with 8 hour battery packs and fixtures supplied from a Class IE battery through a normally deenergized contactor. The contactor control circuit monitors the normal ac lighting feed and automatically energizes the fixtures from one Class IE battery upon loss of ac power. The contactor, switch, wiring, raceways, and fixture mounting for this system are equivalent to Class IE with regard to separation, color coding, and seismic supports.

~~One and one-half hour battery units are used in the turbine building and the hot machine shop~~. Each unit is connected to the normal lighting ac source for maintaining the charge and is automatically transferred to its internal batteries upon loss of ac power.

battery

9.5.3.3 Failure Analysis

~~The emergency lighting system is designed to provide lighting in areas used during safe shutdown, desig~~ event of loss of offsite po batteries, as outlined in S ~~these areas~~ is powered from loss of offsite power. Refe

The emergency lighting strategy involves a diverse approach utilizing the following:

- 8-hour fixed battery units for the locations that may require long term attendance in support of safe shutdown. These locations are identified in E-1F9900.

- Portable (hard hat mounted) lighting for illuminating implementing procedures, safe shutdown equipment, and the access egress routes to the equipment. This will be the primary emergency lighting method for most locations.

- 1.5-hour fixed battery units for firefighting activities, life safety access/egress, and supplementary lighting to portable lighting.

Remaining fixed emergency lighting units for the powerblock have 1.5 hour battery capacity, which provides illumination for fire fighting activities, life safety access/egress, and supplemental lighting to portable lighting.

Document WIP-E-1F9900-010-A-1, "Post-Fire Safe Shutdown Operator Manual Actions"
(68 pages)

WIP-E-1F9900-010-A-1
Post-Fire Safe Shutdown Operator Manual Actions

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1.0 Purpose

1.1 The purpose of this document is to evaluate the feasibility and reliability of operator manual actions (OMA) that are potentially necessary to ensure the availability of a post-fire safe shutdown (PFSSD) success path to achieve and maintain hot standby conditions, in response to a single fire event outside the Control Room.

1.2 The OMAs, which are for 10 CFR 50 Appendix R, Section III.G.2, fire areas, are evaluated for feasibility and reliability utilizing the guidance provided in NUREG-1852.

1.3 This document also evaluates the emergency lighting strategy used by the Station for illuminating implementing procedures, safe shutdown equipment, and the respective access egress routes to the equipment in support of PFSSD or a non-fire event resulting in the loss of all AC power.

2.0 Scope

2.1 This feasibility and reliability review is applicable to OMAs, as defined in Section 4.12. Attachment A summarizes the OMAs, and the fire areas affected.

2.2 Consistent with the scope of NUREG-1852, actions taken within the Control Room that are potentially necessary to mitigate or prevent the undesirable affects of fire induced spurious equipment operation are not addressed within this review for feasibility and reliability. Control Room Actions are identified in E-1F9910, *Post-Fire Safe Shutdown Fire Area Analysis*, and procedural guidance is provided in OFN KC-016, *Fire Response*.

2.3 Fire areas that do not require a mitigating action to ensure preservation of a PFSSD success path, are not addressed within this review. Refer to E-1F9910 for the detailed PFSSD analysis for each fire area.

2.4 Actions required for transition to cold shutdown are not included. Hot standby is a safe, stable condition for the plant. Consistent with 10 CFR 50 Appendix R, Section III.G.1.b, cold shutdown repairs are required to be completed within 72 hours. However, cold shutdown is not required to be achieved within 72 hours.

2.5 The emergency lighting strategy evaluated in Attachment E of this document supporting the following procedures:

- OFN RP-017, Control Room Evacuation
- OFN KC-016, *Fire Response*
- EMG C-0, *Loss of All AC Power*
- OFN NB-034, *Loss of All AC Power - Shutdown Conditions*

The on shift operator responsible for OFN KC-016 OMAs is required to carry a radio on their person in effort to improve communication diversity.

5.1.10 Portable Equipment

The portable equipment needed to successfully implement the OMA was identified and reviewed for availability and dedication to PFSSD, where appropriate.

In addition to the radio discussed above, the on shift operator responsible for OFN KC-016 OMAs is required to carry on their person the following portable equipment:

- Hand tool for cutting wire tab type locking devices on components that potentially would be required to be manipulated.
- Master key to unlock electronic card reader controlled doors, in the event electronic door function is affected by the fire.
- Portable light to aid access/egress in the event normal lighting is affected by the fire.
- Key for ABFHC0002 and ABFHC0003 enclosure housings.

5.1.11 Personnel Protective Equipment (PPE)

The personnel protective equipment required to support the performance of the OMA is identified and assessed for availability. Hard hat, safety glasses, hearing protection, and gloves are not included in this review since this is the standard PPE complement, imposed by the WCNOC Safety Manual, for entry into industrial portions of the plant.

5.1.12 Procedures and Training

Each OMA was reviewed to ensure it is included within OFN KC-016, *Fire Response*. This procedure contains the actions potentially necessary to ensure availability of a PFSSD success path following a single fire event outside the Control Room. The Operations department owns this procedure. Training for the procedure is on a biennial cycle. The procedure is also exercised during fire brigade drill activities that involve postulated fires affecting PFSSD success path. The procedure identifies the following information, per fire area with a potential OMA, to ensure Control Room personnel are aware of the potential fire impact on safe shutdown.

- Equipment susceptible to fire induced spurious operation that could affect PFSSD success path.
- OMAs that are required to achieve PFSSD hot standby.
- OMA to mitigate spurious equipment operation.

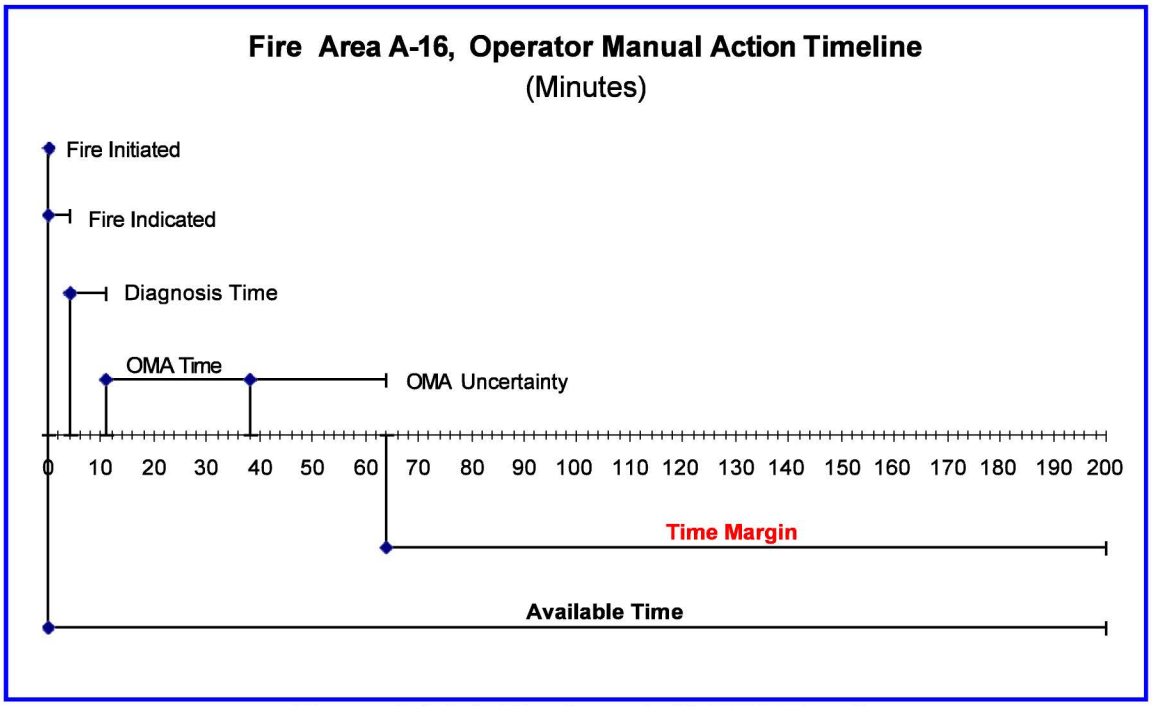

Figure 8.1.4-1, Fire Area A-16 OMA Timeline

8.1.5 Reliability Analysis of Time Available to Perform Manual Actions

As discussed in Section 5.1.5, an OMA is considered reliable provided that a Time Margin remains when applying Fire Indicated Time, Diagnosis Time, OMA Implementation Time, and OMA Uncertainty Time, within the OMA event timeline. The OMA Timeline for Fire Area A-16 reveals that a one hundred thirty six (136) minute time margin remains. Application of the uncertainty time provides reasonable assurance that the OMAs are dependable, reliable, and can be performed with a high rate of success.

8.1.6 Environmental Factors

Habitable environmental conditions will be present for performance of the OMAs. The postulated fire event is within the general corridor area of the Auxiliary Building 2026' elevation. The location of the OMAs is within the Main Steam Enclosure on the 2037'-7" elevation of the Auxiliary Building (Fire Area A-23). Based on fire barrier separation, the fire will be confined to Fire Area A-16. Access to Fire Area A-23 does not require transition through Fire Area A-16. The travel path and location of the equipment requiring manipulation are physically separated from the fire by rated fire barriers. The smoke propagation review documented in Section 5.1.6 determined that the described OMA implementation would not be impeded by smoke migration from the fire event.

Hard hat mounted portable lighting, evaluated in Attachment E, is the primary emergency lighting means for illumination of potential egress paths, the component requiring OMA manipulation, and emergency equipment cabinet necessitating access for retrieval of personal protective equipment. Existing fixed emergency lighting provides 1.5 hour supplemental lighting to the portable lighting. Normal radiation conditions within the areas of concern will not be adversely affected by the fire and subsequent spurious equipment operation.

Hard hat mounted portable lighting, evaluated in Attachment E, is the primary emergency lighting means for illumination of potential egress paths, the component requiring OMA manipulation, and emergency equipment cabinet necessitating access for retrieval of personal protective equipment. Existing fixed emergency lighting provides 1.5 hour supplemental lighting to the portable lighting. Normal radiation, temperature, and humidity conditions within the OMA area will not be adversely affected by the fire and subsequent spurious equipment operation.

There are no physical impediments in proximity to the manual action component that would significantly delay or prevent required manipulation. No special equipment, related to environmental condition, is necessary for performance of the OMA.

8.2.7 Equipment Functionality and Accessibility

No equipment support functions are required for successful manual action implementation. The OMA component is physically separated from the fire event by several fire-rated barriers. This ensures that the fire and its effects do not adversely affect the credited equipment.

The operator responsible for OFN KC-016 OMAs carries a master key that can be used to open electronically controlled doors in the event that the fire has negatively affected the normal card key access means. All electronically controlled doors are provided with this secondary access arrangement. This ensures that the postulated fire will not prevent egress through doors provided with electronic access control.

8.2.8 Available Indications

Point addressable smoke detection is provided for Cable Chase 3419. Upon detector activation, main fire alarm panel KC-008, located in the Control Room, will annunciate a fire alarm condition with a descriptive location of the detector in alarm. This will likely be the first indication of a fire event within the cable chase.

To diagnose spurious operation of containment spray, the pump breaker status indication, containment spray flow indication, containment pressure indication, or RWST level indication needs to be available. The following instrumentation is unaffected by the fire and is available to assist Control Room diagnosis of spurious containment spray actuation:

- RWST level indicators BNLI0931 and BNLI933.
- Containment pressure indicators GNPI0934 and GNPI0936.

8.2.9 Communications

A fire in this area could affect the Gaitronics and 900 MHz radio systems. The OMA does not require constant communication with the Control Room. As previously discussed, the operator assigned OFN KC-016 OMA duty will report to the Control Room for instruction following fire brigade callout. This approach allows the Control Room operators to provide face-to-face direction for the OMA. Once the OMA has been

8.3.6 Environmental Factors

Habitable environmental conditions will be present for performance of the OMAs. The postulated fire event is within Lower Cable Spreading Room on the 2032' elevation of the Control Building. The location of the OMA for isolating KAV0201 is in an adjacent structure on the 2000' elevation of the Auxiliary Building, within the south Pipe Penetration Room. The location of the OMA for stopping PEN01A containment spray is located on the 2000' elevation of the Control Building, within the north ESF Switchgear Room.

Based on fire barrier separation, the fire will be confined to Fire Area C-21. The travel path and location of the equipment requiring manipulation are physically separated from the fire by rated fire barriers. The smoke propagation review documented in Section 5.1.6 determined that the described OMA implementation would not be impeded by smoke migration from the fire event.

Hard hat mounted portable lighting, evaluated in Attachment E, is the primary emergency lighting means for illumination of potential egress paths, the component requiring OMA manipulation, and emergency equipment cabinet necessitating access for retrieval of personal protective equipment. Existing fixed emergency lighting provides 1.5 hour supplemental lighting to the portable lighting. Normal radiation, temperature, and humidity conditions within the OMA areas will not be adversely affected by the fire and subsequent spurious equipment operation.

There are no physical impediments in proximity to the manual action components that would significantly delay or prevent required manipulation. No special equipment, related to environmental condition, is necessary for performance of the OMAs.

8.3.7 Equipment Functionality and Accessibility

No equipment support functions are required for successful manual action implementation. The OMA components are physically separated from the fire event by several fire-rated barriers. This ensures that the fire and its effects do not adversely affect the credited equipment.

The operator responsible for OFN KC-016 OMAs carries a master key that can be used to open electronically controlled doors in the event that the fire has negatively affected the normal card key access means. All electronically controlled doors are provided with this secondary access arrangement. This ensures that the postulated fire will not prevent egress through doors provided with electronic access control.

8.3.8 Available Indications

Point addressable smoke detection is provided for the Lower Cable Spreading Room. Upon detector activation, main fire alarm panel KC- 008, located in the Control Room, will annunciate a fire alarm condition with a descriptive location of the detector in alarm. This will likely be the first indication of a fire event within the area.

8.4.5 Reliability Analysis of Time Available to Perform Manual Actions

As discussed in Section 5.1.5, an OMA is considered reliable provided that a Time Margin remains when applying Fire Indicated Time, Diagnosis Time, OMA Implementation Time, and OMA Uncertainty Time, within the OMA event timeline. The OMA Timeline for Fire Area C-22 reveals that a thirty nine (39) minute time margin remains. Application of the uncertainty time provides reasonable assurance that the OMA is dependable, reliable, and can be performed with a high rate of success.

8.4.6 Environmental Factors

Habitable environmental conditions will be present for performance of the OMA. The postulated fire event is within Upper Cable Spreading Room on the 2073'-6" elevation of the Control Building. The location of the OMA for stopping PEN01B containment spray is located on the 2000' elevation of the Control Building within the south ESF Switchgear Room.

The fire will be confined to Fire Area C-22 Upper Cable Spreading Room. The travel path and location of the equipment requiring manipulation are physically separated from the fire by multiple fire-rated barriers. The smoke propagation review documented in Section 5.1.6 determined that the described OMA implementation would not be impeded by smoke migration from the fire event.

Hard hat mounted portable lighting, evaluated in Attachment E, is the primary emergency lighting means for illumination of potential egress paths, the component requiring OMA manipulation, and emergency equipment cabinet necessitating access for retrieval of personal protective equipment. Existing fixed emergency lighting provides 1.5 hour supplemental lighting to the portable lighting. Normal radiation, temperature, and humidity conditions will not be adversely affected by the fire and subsequent spurious equipment operation.

There are no physical impediments in proximity to the manual action component that would significantly delay or prevent required manipulation. No special equipment, related to environmental condition, is necessary for performance of the OMA.

8.4.7 Equipment Functionality and Accessibility

No equipment support functions are required for successful manual action implementation. The component requiring manipulation is an electrical breaker. The breaker is readily accessible for manipulation. It is physically separated from the fire event by several fire-rated barriers. This ensures that the fire and its effects do not adversely affect the credited equipment.

The operator responsible for OFN KC-016 OMAs carries a master key that can be used to open electronically controlled doors in the event that the fire has negatively affected the normal card key access means. All electronically controlled doors are provided with this secondary access

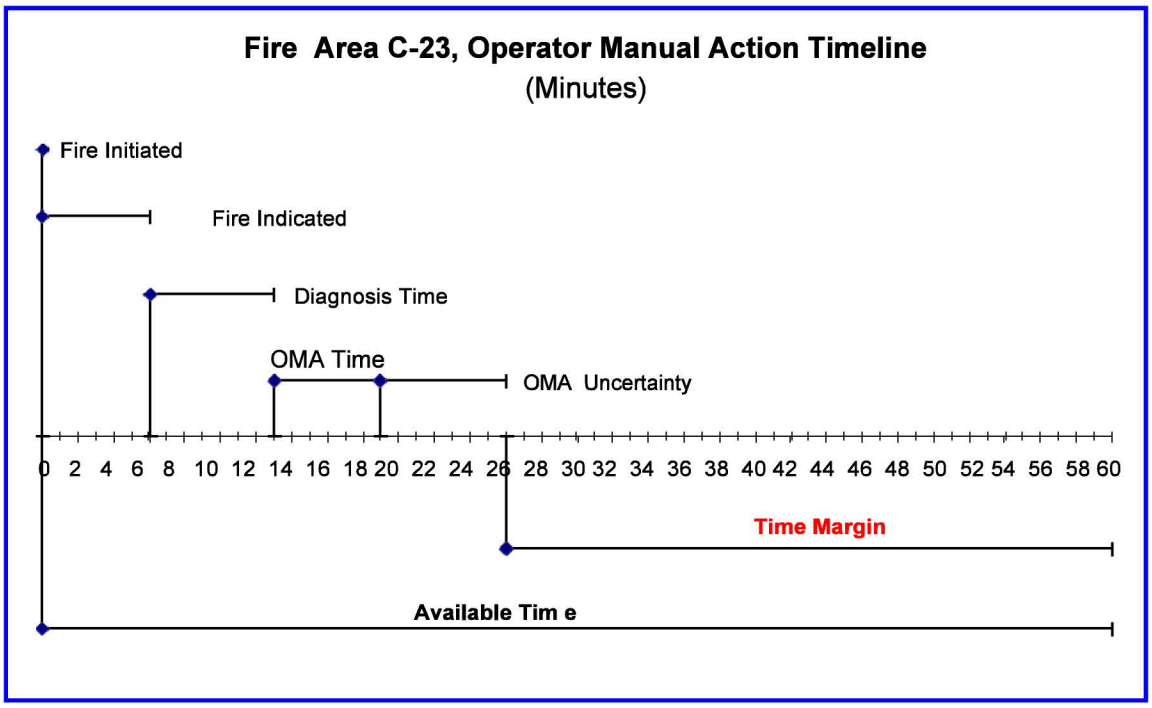

Figure 8.5.4-1, Fire Area C-23 OMA Timeline

8.5.5 Reliability Analysis of Time Available to Perform Manual Actions

As discussed in Section 5.1.5, an OMA is considered reliable provided that a Time Margin remains when applying Fire Indicated Time, Diagnosis Time, OMA Implementation Time, and OMA Uncertainty Time, within the OMA event timeline. The OMA Timeline for Fire Area C-23 reveals that a thirty four (34) minute time margin remains. Application of the uncertainty time provides reasonable assurance that the OMA is dependable, reliable, and can be performed with a high rate of success.

8.5.6 Environmental Factors

Habitable environmental conditions will be present for performance of the OMA. The postulated fire event is within Cable Chase 3505 located on the 2032' elevation of the Control Building. The location of the OMA for stopping PEN01B containment spray is located on the 2000' elevation of the Control Building within the south ESF Switchgear Room.

The fire will be confined to the Fire Area C-23 Cable Chase of origin, which contains no ventilation openings. The travel path and location of the equipment requiring manipulation are physically separated from the fire by multiple fire rated barriers, ensuring that smoke propagation and fire fighting activities will not present an egress impediment.

Hard hat mounted portable lighting, evaluated in Attachment E, is the primary emergency lighting means for illumination of potential egress paths, the component requiring OMA manipulation, and emergency equipment cabinet necessitating access for retrieval of personal protective equipment. Existing fixed emergency lighting provides 1.5 hour supplemental lighting to the portable lighting. Normal radiation, temperature, and humidity

Hard hat mounted portable lighting, evaluated in Attachment E, is the primary emergency lighting means for illumination of potential egress paths, the component requiring OMA manipulation, and emergency equipment cabinet necessitating access for retrieval of personal protective equipment. Existing fixed emergency lighting provides 1.5 hour supplemental lighting to the portable lighting. Normal radiation, temperature, and humidity conditions within the OMA area will not be adversely affected by the fire and subsequent spurious equipment operation.

There are no physical impediments in proximity to the manual action component that would significantly delay or prevent required manipulation. No special equipment, related to environmental condition, is necessary for performance of the OMA.

8.6.7 Equipment Functionality and Accessibility

No equipment support functions are required for successful manual action implementation. The OMA component is physically separated from the fire event by several fire rated barriers. This ensures that the fire and its effects do not adversely affect the credited equipment.

The operator responsible for OFN KC-016 OMAs carries a master key that can be used to open electronically controlled doors in the event that the fire has negatively affected the normal card key access means. All electronically controlled doors are provided with this secondary access arrangement. This ensures that the postulated fire will not prevent egress through doors provided with electronic access control.

8.6.8 Available Indications

Point addressable smoke detection is provided for Cable Chase 3504. Upon detector activation, main fire alarm panel KC-008, located in the Control Room, will annunciate a fire alarm condition with a descriptive location of the detector in alarm. This will likely be the first indication of a fire event within the cable chase.

To diagnose spurious operation of containment spray, the pump breaker status indication, containment spray flow indication, containment pressure indication, or RWST level indication needs to be available. The following instrumentation is unaffected by the fire and is available to assist Control Room diagnosis of spurious containment spray actuation:

- RWST level indicators BNLI0931 and BNLI933.
- Containment pressure indicators GNPI0934 and GNPI0936.

8.6.9 Communications

A fire in this area could affect the Gaitronics system. The 900 MHz radio communication system is unaffected by the fire. The OMAs do not require constant communication with the Control Room. After initially reporting to the Control Room, the operator will receive face-to-face direction regarding OMA implementation. The operator may then use the radio system as necessary, or report directly back to the Control Room for further instruction.

Hard hat mounted portable lighting, evaluated in Attachment E, is the primary emergency lighting means for illumination of potential egress paths, the component requiring OMA manipulation, and emergency equipment cabinet necessitating access for retrieval of personal protective equipment. Existing fixed emergency lighting provides 1.5 hour supplemental lighting to the portable lighting. Normal radiation, temperature, and humidity conditions will not be adversely affected by the fire and subsequent spurious equipment operation.

There are no physical impediments in proximity to the manual action component that would significantly delay or prevent required manipulation. No special equipment, related to environmental condition, is necessary for performance of the OMA.

8.7.7 Equipment Functionality and Accessibility

No equipment support functions are required for successful manual action implementation. The component requiring manipulation is an electrical breaker. The breaker is readily accessible for manipulation. It is physically separated from the fire event by several fire-rated barriers. This ensures that the fire and its effects do not adversely affect the credited equipment.

The operator responsible for OFN KC-016 OMAs carries a master key that can be used to open electronically controlled doors in the event that the fire has negatively affected the normal card key access means. All electronically controlled doors are provided with this secondary access arrangement. This ensures that the postulated fire will not prevent egress through doors provided with electronic access control.

8.7.8 Available Indications

Point addressable smoke detection is provided for Cable Chase 3617. Upon detector activation, main fire alarm panel KC-008, located in the Control Room, will annunciate a fire alarm condition with a descriptive location of the detector in alarm. This will likely be the first indication of a fire event within the cable chase.

To diagnose spurious operation of containment spray, the pump breaker status indication, containment spray flow indication, containment pressure indication, or RWST level indication needs to be available. The following instrumentation is unaffected by the fire and is available to assist Control Room diagnosis of spurious containment spray actuation:

- RWST level indicators BNLI0930 and BNLI0932.
- Containment pressure indicators GNPI0935 and GNPI0937.

8.7.9 Communications

A fire in this area could affect the Gaitronics system. The 900 MHz radio communication system is unaffected by the fire. The OMA does not require constant communication with the Control Room. After initially reporting to the Control Room, the operator will receive face-to-face

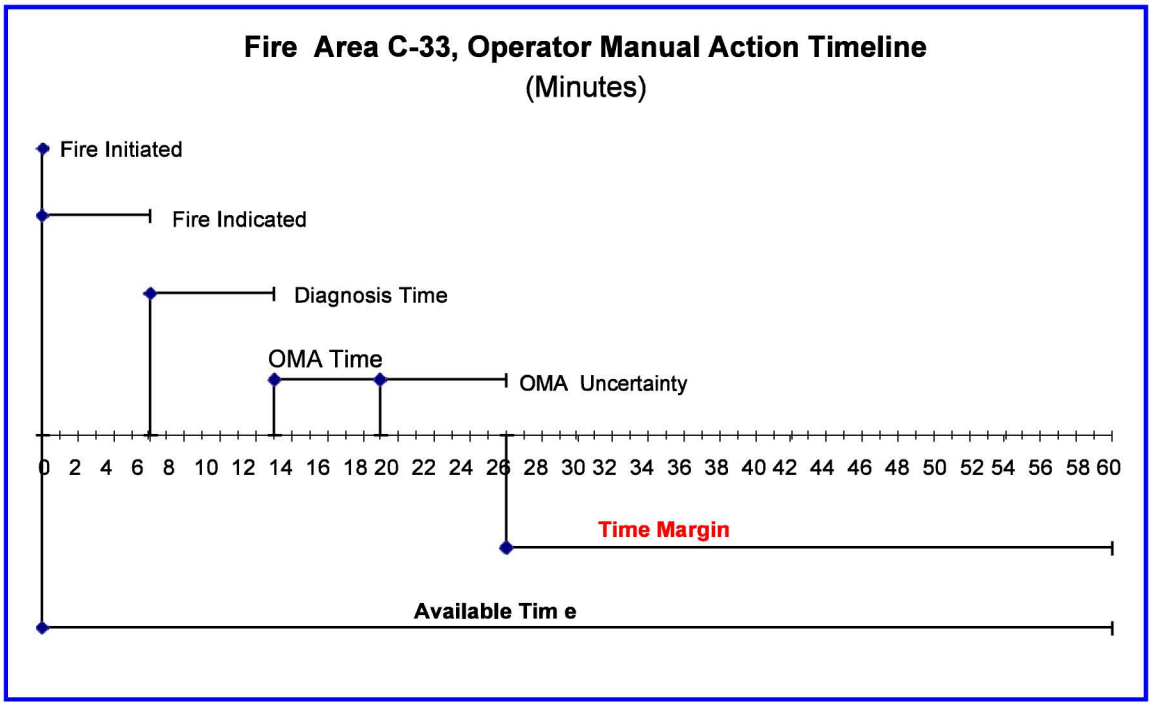

Figure 8.8.4-1, Fire Area C-33 OMA Timeline

8.8.5 Reliability Analysis of Time Available to Perform Manual Actions

As discussed in Section 5.1.5, an OMA is considered reliable provided that a Time Margin remains when applying Fire Indicated Time, Diagnosis Time, OMA Implementation Time, and OMA Uncertainty Time, within the OMA event timeline. The OMA Timeline for Fire Area C-33 reveals that a thirty four (34) minute time margin remains. Application of the uncertainty time provides reasonable assurance that the OMA is dependable, reliable, and can be performed with a high rate of success.

8.8.6 Environmental Factors

Habitable environmental conditions will be present for performance of the OMA. The postulated fire event is within Cable Chase 3804 located on the 2073'-6" elevation of the Control Building. The location of the OMA for stopping PEN01B containment spray is on the 2000' elevation of the Control Building within the south ESF Switchgear Room.

The fire will be confined to the Fire Area C-33 Cable Chase of origin, which contains no ventilation openings. The travel path and location of the equipment requiring manipulation are physically separated from the fire by multiple fire rated barriers, ensuring that smoke propagation and fire fighting activities will not present an egress impediment.

Hard hat mounted portable lighting, evaluated in Attachment E, is the primary emergency lighting means for illumination of potential egress paths, the component requiring OMA manipulation, and emergency equipment cabinet necessitating access for retrieval of personal protective equipment. Existing fixed emergency lighting provides 1.5 hour supplemental lighting to the portable lighting. Normal radiation, temperature, and humidity

Attachment E

to

E-1F9900

Emergency Lighting Strategy for Safe Shutdown

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E.1 Purpose

E.1.1 The purpose of this Attachment is to evaluate the acceptability of utilizing the following diverse emergency lighting approach for illuminating safe shutdown implementing procedures, equipment, and the respective access egress routes to the equipment in support of post-fire safe shutdown (PFSSD) or a non-fire event resulting in the loss of all AC power.

- 8-hour fixed battery units for the locations that may require long term attendance in support of safe shutdown. These units and respective locations are identified in Table E.2.5-1.

- Portable (hard hat mounted) lighting for illuminating safe shutdown implementing procedures, equipment, and the access egress routes to the equipment. This will be the primary emergency lighting method for most locations. This attachment will focus on evaluating portable lighting as an acceptable primary emergency lighting means, since fixed emergency lighting is the standard.

- 1.5-hour fixed battery units for firefighting activities, life safety access/egress, and supplementary lighting to portable lighting.

E.2 Scope

E.2.1 Operator manual actions (OMAs) located outside the Control Room for a fire outside the Control Room. These OMAs are evaluated in Attachment A of this document and are implemented by OFN KC-016, *Fire Response.* WIP-E-1F9900-004-A-1, Rev. 1 for E-1F9900 was approved by the NRC via License Amendment 191 (Reference E.15.3). E-1F9900 has been revised since License Amendment 191.

E.2.2 OMAs for a fire in the Control Room requiring Control Room evacuation. These OMAs are evaluated in E-1F9915 and are implemented by OFN RP-017, *Control Room Evacuation*. A markup of E-1F9915, Rev. 5, was approved by the NRC via License Amendment 214 (Reference E.15.6). E-1F9915 has been revised since License Amendment 214.

E.2.3 Operator Actions not within the Control Room, the Auxiliary Shutdown Panel Room, or at the Emergency Diesel Generator Control Panels KJ121 or KJ122 necessary for safe shutdown absent a fire. These are described in USAR Section 9.5.3.2.3 and per LER 95-005 (Reference E.15.33) include the OMAs for EMG C-0, *Loss of All AC Power*, and OFN NB-034, *Loss of All AC Power – Shutdown Conditions*.

E.2.4 Access and egress routes to all equipment locations supporting OMAs in Sections E.2.1 through E.2.3 above.

E.2.5 For the Control Room, the Auxiliary Shutdown Panel Room, the Emergency Diesel Generator Panels (KJ121 or KJ122), and the Operations hard hat rack outside of the Control Room, fixed emergency lighting units with 8-hour battery capacity will continue to be credited in the emergency lighting illumination response strategy for safe shutdown. These emergency lighting units are identified in Table E.2.5-1.

Table E.2.5-1, Fixed Emergency Light Units Credited for Safe Shutdown

Asset	Location
QDC036	Control Room Equipment Cabinet Area
QDC037	Control Room
QDC038	Control Room
QDC039	Control Room
QDC040	Control Room
QDC057 / QDC067	Control Room Equipment Cabinet Area
QDC060 / QDC061	Control Room Shift Manager's Office
QDT018	Comm Corridor – Operations' Hard Hat Rack
QDA053	Auxiliary Shutdown Panel Room
QDC046	'A' Emergency Diesel Generator Control Panel KJ121
QDC047	'A' Emergency Diesel Generator Panel NE107
QDC048	'A' Emergency Diesel Generator Panel NG03D
QDC052	'B' Emergency Diesel Generator Panel KJ122 and NE106
QDC053	'B' Emergency Diesel Generator Panel NE106
QDC054	'B' Emergency Diesel Generator Panel NG04D

Note: Multiple industry terms such as operator manual action, operator action, post-fire safe shutdown action, recovery action, and safe shutdown action are used to describe the actions taken by Operations to achieve and maintain safe shutdown following an event. Considering this, operator manual action (OMA) will be used as the inclusive term within this Attachment for actions taken by Operations to achieve and maintain safe shutdown following an event.

E.3 Background

Historically, Wolf Creek has credited fixed emergency lighting with 8-hour battery capacity as the means for illuminating safe shutdown equipment and egress paths to the safe shutdown equipment. This was driven by the regulatory requirements identified in Section E.4.1 below. Wolf Creek continues to maintain a deterministic fire protection license bases, with no plan to transition the fire protection program to a NFPA 805 risk informed license bases. However, the Station does desire to apply the flexibility allowed by NFPA 805 (identified in Section E.4.6) regarding emergency lighting for OMAs. In multiple instances NFPA 805 plants have successfully evaluated the use of portable lighting as the primary emergency lighting means for the illumination of OMAs. The

NFPA 805 evaluation approach utilized for the portable emergency lighting strategy is comparable to that conducted within this evaluation.

The fixed emergency lighting historically credited for illuminating safe shutdown equipment and egress paths to the safe shutdown equipment has been Teledyne Big Beam Model S6L with Model L6100S battery, as shown in Figure E.3-1. This emergency lighting unit is maintenance intensive, particularly regarding the refillable lead acid battery. Addition of battery electrolyte is frequently required, especially in high temperature locations. This results in a high number of preventative maintenance (PM) activities in the effort to ensure unity functionality. An alternative approach for OMA emergency lighting is desired, with portable lighting being the selected resolution, as it is a relatively maintenance free option.

Figure E.3-1, Teledyne Big Beam Emergency Lighting Unit

The lamp options approved for use at Wolf Creek for the Teledyne Big Beam Emergency lighting units are identified in Table E.3-1.

Table E.3-1, Teledyne Big Beam Lamp Data

Lamp Model	Type	Power (watt)	Distance Where Illumination is 1 foot-candle (ft.)
Par 36	Halogen	12	26
Par 36	LED	4	15
Par 46	Incandescent	21	24
Par 46	LED	4	15

The use of light emitting diodes (LEDs) and the improvement in battery longevity for small device application has resulted in advancements in flashlight technology in recent years. This now makes portable lighting viable as a primary option within the emergency lighting strategy for the Station. The Fenix HM65R headlamp assembly is adequate compensation for the lower illumination distance provided by the LED lamp for Teledyne Big Beam emergency lighting unit application.

E.4 Regulatory Information

E.4.1 10 CFR 50 Appendix R, Fire Protection Program for Nuclear Power Facilities Operating Prior to January 1, 1979.

Section III.J, Emergency lighting

"Emergency lighting units with at least an 8-hour battery power supply shall be provided in all areas needed for operation of safe shutdown equipment and in access and egress routes thereto."

As identified in the Fire Protection Regulatory Bases (Reference E.15.32), Appendix R to 10 CFR 50 does not apply to Wolf Creek as a Part 50 Rule. Wolf Creek's relationship to Appendix R is established in Appendix 9.5E of the USAR as part of the approved Fire Protection Program (FPP) documented in the USAR. USAR Appendix 9.5E is a design comparison of the Wolf Creek FPP to 10 CFR 50 Appendix R.

E.4.2 Regulatory Guide 1.189, Fire Protection for Nuclear Power Plants, Revision 4

Section 4.1.6, Emergency Lighting

Emergency lighting should be provided throughout the plant as necessary to support fire suppression actions and safe-shutdown operations, including access and egress pathways to safe-shutdown areas during a fire event.

Section 4.1.6.2, Post Fire Shutdown

Lighting is vital to post-fire safe shutdown and emergency response in the event of fire. The licensee should provide suitable fixed and portable emergency lighting, as follows:

a. *Fixed, self-contained lighting consisting of units with individual 8-hour minimum battery power supplies should be provided in areas needed for operation of safe-shutdown equipment and for access and egress routes to these areas.*

   The level of illumination provided by emergency lighting in access routes to and in areas where shutdown functions are performed is sufficient to enable an operator to reach that area and perform the shutdown functions. At the alternative or dedicated shutdown panels, the illumination levels should be sufficient for control panel operators. If a licensee has provided emergency lighting in accordance with Section III.J of Appendix R to 10 CFR Part 50, the licensee should verify by field testing that this lighting is adequate to perform the intended tasks.

   Routine maintenance and initial and periodic field testing of emergency lighting systems should ensure their ability to support access, egress, and

operations activities for the full 8-hour period accounting for anticipated environmental conditions, battery conditions, and bulb life.

b. Suitable battery-powered portable hand lights should be provided for emergency use by the fire brigade and other operations personnel required to achieve safe plant shutdown.

If a central battery or batteries power the emergency lights, the distribution system should contain protective devices necessary to preclude a fire in one area from causing a loss of emergency lighting in any unaffected area required for safe-shutdown operations.

Wolf Creek is not committed to Regulatory Guide 1.189. The Purpose section of the Regulatory Guide states the following:

This regulatory guide (RG) describes an approach that is acceptable to the staff of the U.S. Nuclear Regulatory Commission (NRC) to meet the regulatory requirements of Title 10 of the Code of Federal Regulations (10 CFR) section 50.48(a) and (b) (Ref. 1), and 10 CFR Part 50, Appendix R, "Fire Protection Program for Nuclear Power Facilities Operating Prior to January 1, 1979" (Ref. 2). These regulations state the requirements governing a civilian nuclear power generating plant's fire protection program (FPP).

E.4.3 NUREG-0800, Standard Review Plan

Section 9.5.3, Lighting Systems

The emergency lighting system(s) is acceptable if the integrated design of the system(s) will provide adequate emergency station lighting in all areas, required for fire fighting, control and maintenance of equipment used for implementing safe shutdown of the plant during all plant operating conditions, and the access routes to and from these areas.

The lighting systems designs will be acceptable if they conform to the lighting levels recommended in NUREG-0700, which is based on the Illuminating Engineering Society of North America (IESNA) Lighting Handbook as related to systems design and illumination levels recommended for industrial facilities.

Volume 1 of the Safety Evaluation Report for Wolf Creek (Reference E.15.36) identifies that the July 1981 version of NUREG-0800 was used in the review of the of Wolf Creek Generating Station.

E.4.4 NUREG-0700, Human-System Interface Design Review Guidelines (Rev. 3)

12.1.2.4-4 Emergency Lighting Levels

The control room emergency illumination system should be designed to provide a minimum illumination level of 108 lux (10 fc) at all work stations in the main operating area.

Volume 1 of the Safety Evaluation Report for Wolf Creek (Reference E.15.36) identifies that Wolf Creek was required to conduct a detailed control room design review in accordance with NURE-0700 [August 1981 edition].

E.4.5 NUREG-1852, Demonstrating the Feasibility and Reliability of Operator Manual Actions in Response to Fire

Section 4.2.3, Information Regarding Environmental Factors

Emergency lighting should be provided as required in Section III.J of Appendix R to 10 CFR Part 50, or by the plant's approved fire protection program.

Wolf Creek is not committed to NUREG-1852, but it is the guidance document utilized in the OMA feasibility and reliability analysis that was approved by the NRC in License Amendment 191 (Reference E.15.3).

E.4.6 NFPA 805, Performance-Based Standard for Fire Protection for Light Water Reactor Electric Generating Plants (2001 Edition)

Section 1.5.3(2), Provide adequate protection, including emergency lighting, for essential personnel to perform necessary safety functions as a result of a fire event.

Section B.5.2(3), The lighting should be evaluated to ensure sufficient lighting is available to perform the intended action.

As identified in Section E.3 Wolf Creek is not committed to NFPA 805.

E.4.7 NFPA 101, Life Safety Code (2021 Edition)

Section 7.8.1.3, The floors and other walking surfaces within an exit and within the portions of the exit access and exit discharge designated in 7.8.1.1 shall be illuminated as follows:

(1) During conditions of stair use, the minimum illumination for new stairs shall be at least 10 foot-candles (108 lux), measured at the walking surfaces.

(2) The minimum illumination for floors and other walking surfaces, other than new stairs during conditions of stair use, shall be to values of at least 1 foot-candle (10.8 lux), measured at the floor.

Section 7.9.2.1.1, Emergency lighting facilities shall be arranged to provide initial illumination that is not less than an average of 1 foot-candle (10.8 lux) and, at any point, not less than 0.1 foot-candle (1.1 lux), measured along the path of egress at floor level.

Section 7.9.2.1.2, Illumination levels shall be permitted to decline to not less than an average of 0.6 foot-candle (6.5 lux) and, at any point, not less than 0.06 foot-candle (0.65 lux) at the end of 1-1/2 hours.

Wolf Creek is not committed to NFPA 101. It is utilized as a guide for the design and maintenance of Wolf Creek facilities.

E.4.8 License Event Report 95-005, Failure To Develop Adequate Fire Protection Program Emergency Lighting (Reference E.15.33)

In LER 95-005, Wolf Creek identified the following three procedures that contain safe shutdown actions requiring emergency lighting:

- OFN RP-017, *Control Room Evacuation*
- EMG C-0, *Loss of All AC Power*
- OFN NB-034, *Loss of All AC Power - Shutdown Conditions*

E.5 Updated Safety Analysis Report

The Updated Safety Analysis Report (USAR) has been revised by change package 20283 to reflect that portable lighting is the primary credited means for illuminating safe shutdown implementing procedures, equipment, and the respective access egress routes to the equipment in the event of a loss of off-site power, a design basis event, or a fire, that renders normal lighting and standby lighting unavailable. The supporting License Amendment Request generated from the change package addresses the USAR 9.5.3.2.3 discussion that emergency lighting is also provided to support firefighting efforts.

E.6 Portable Lighting Selection

Operations personnel who are responsible for manipulating safe shutdown equipment are required to wear ANSI approved protective hard hats as part of their personal protective gear. The portable emergency lighting will attach to the required hard hat. Alternatively, it can be directly attached to the head, via the elastic straps, if desired. The portable emergency lighting equipment supplied is as follows:

- Commercially available, Fenix HM65R dual LED beam headlamp, that can be attached to a standard hard hat via an adhesive headlamp attachment or elastic strap with helmet clips. Both attachment options may be used together if desired.

- The headlamp can be powered by a single model 18650 rechargeable battery or two disposable CR123 / CR123A batteries. The 18650 rechargeable battery tested in Section E.7 of this document was a 3500 mAh battery (Fenix model ARB-L18-3500). Fenix is now packaging the HM65R headlamp with a 3400 mAh battery (Fenix model ARB-L18-3400). The ARB-L18-3400 is an acceptable alternative, as the capacity reduction is less than 3% which still provides ample margin when comparing performance to the fixed Teledyne Big Beam emergency light. Each of the rechargeable battery models is provided with an electronic circuit that protects it from over charge, over discharge, overheating, and short circuit. In the event that the electronic circuit protection fails, pressure relief vents are provided to expel waste gas generated from an internal short. Additionally, as documented in References E.15.42 and E.15.43, the rechargeable batteries conform to the testing requirements of section 38.3 from the United Nations (UN) Publication: *Recommendations on the Transport of Dangerous Goods Manual of Tests and Criteria*. Section UN 38.3 addresses testing requirements for lithium metal and lithium ion batteries that are shipped internationally. The UN required testing includes: altitude simulation, thermal, vibration, shock, external short circuit, impact/crush, overcharge, and forced discharge. The protection features described above and the independent testing confirming UN38.3 conformance, provides reasonable assurance that consequential failure for the Fenix model ARB-L18-3400 or ARB-L18-3500 rechargeable battery is unlikely.

See Figure E.6-1 for the headlamp attached to a standard hard hat via an adhesive headlamp attachment. Figure E.6-2 is the head lamp attached with adhesive headlamp attachment and elastic strap with helmet clips. Attachment E.1 provides the detailed product specifications for the headlamp, adhesive attachment, and rechargeable battery. The Fenix HM65R stated performance is per ANSI/PLATO FL 1 criteria for the following:

- Light Output - Total light output measured in Lumens.

- Run Time - Tested with fresh batteries from 30 seconds after the light is turned on until the light output reaches 10% of the initial measurement.

- Beam Distance - The distance, measured in meters, at which the light projects a useful amount of light, measured at 0.25 lux. (0.25 lux is approximately the equivalent of light emitted from a full moon "on a clear night in an open field.")

- Peak Beam Intensity - The brightest point in the beam measured in candela.

- Impact Resistance - The height, measured in meters, from which the light can be dropped onto cured concrete and still work properly. This testing is completed by dropping the product six (6) times using drop orientations that approximate each side of a cube. Dropped samples cannot have any visible cracks or breaks and the light must remain fully functional.

- Water Proof - Water submersion depth rating, measured in meters. This test must be done after impact resistance testing is completed to ensure water tightness under real-life conditions.

In addition to the testing required by ANSI/PLATO FL 1, the headlamp is subject to the following test protocols to ensure reliability in extreme environments:

- Shakeout Test - Evaluates the scratch and wear resistance of the light's surface.

- Bending Test – Challenges the bending degree and inherent strength of internal wiring systems.

- Salt Spray Test – Puts the light into corrosion provoking conditions beyond what most will ever face.

- Ultraviolet Radiation Test – Monitors the light's performance after intense exposure to UV radiation.

- Environmental Test – Pushes low and high temperature ranges to verify performance at extremes.

- Vibration Test – Jars the light over thousands of cycles to validate resistance to rigorous forces.

- Switch Test – Checks the switch function well over the projected lifespan of the light.

- Temperature Test – determines heat generation and dissipation of the light.

The Fenix HM65R headlamp is not a wireless communication device, as such it does not transmit or receive radio waves. Additionally, Wolf Creek subjected the Fenix HM65R headlamp to a commercially available electromagnetic field (EMF) radiation tester (Lutron EMF-823). Contact readings with the meter sensor and headlamp were 0.00 micro Tesla for all lighting operation modes using both battery types (a rechargeable battery and two CR123 batteries). Therefore, the Fenix HM65R headlamp may be used around components that are sensitive to radio frequency and/or EMF interference.

Figure E.6-1, Fenix HM65R Headlamp on Standard Hard Hat (with adhesive attachment)

Figure E.6-2, Fenix HM65R Headlamp on Standard Hard Hat
(with adhesive attachment, elastic strap and helmet clips)

The Fenix HM65R headlamp selected provides a reliable method for hands free use, excellent lumen output, long LED life, flexibility of multiple lighting modes, long battery life, a battery life indicator, and battery recharging capability. The headlamp has the option for the following lighting configurations:

- Spot Light (turbo, high, medium, and low) – best for distance lighting when traversing from one area to another.

- Flood Light (high, medium, and low) – best for close range lighting such as reading a procedure or manipulating a component.

The headlamp battery level indication for the rechargeable battery is accessed by a single click of either the Spotlight or Floodlight switch with the headlamp in the off position. See Figure E.6-3 for the battery light indicator. Battery life indicator is as follows:

- Four lights on: Battery is charged 81% to 100%
- Three lights on: Battery is charged 61% to 80%
- Two lights on: Battery is charged 41% to 60%
- One light on: Battery is charged 21% to 40%
- One light flashes: Battery is charged between 0% and 20%

Figure E.6-3, Fenix HM65R Headlamp with Battery Charge Status Illuminated

The headlamp is provided with a USB Type C connection. This allows direct charging with a cable via an AC adapter or a Type A USB connection. The connection is for charging only and does not transfer data (Reference E.15.40). Typical battery charging will be provided from a multi-bay battery charger located in the Work Control Center area across from the Control Room.

E.7 Demonstration

E.7.1 Performance Test

In an effort to compare illumination levels between the fixed Teledyne Big Beam emergency lighting, the Fenix HM65R headlamp, and a portable light model (Underwater Kinetics UK4AA-AS2) approved by the NRC for a peer Nuclear Power Plant that has transitioned to NFPA 805, a lighting performance test was conducted. The test method and results are documented in Work Order 21-468651-000. Photos from the performance test are provided in Attachment E.4. A series of tests were conducted as identified in Table E.7.1-1. Relevant illumination test setup information is as follows:

- Portable lighting was attached to ANSI hard that was then zip tied to a step ladder to ensure stability when obtaining illumination level readings.
- The Fenix HM65R headlamp was placed in the High Spotlight mode when discharging batteries for the specified duration.
- Each component light test was in line to the target representing a component in the plant (see Attachment E.4, Photo E.4.A-1).
- Target illumination levels for 8 and 16 hour discharge testing was collected at 5 and 10 ft. distances only.
- Each component light test was conducted a specified distance from the target.
- Aiming for portable lighting and the Teledyne Big Beam unit was adjusted to provide optimum target illumination at each tested distance.
- Only one beam from the Teledyne Big Beam unit was aimed directly at the target, consistent with plant aiming configurations. The remaining beam was configured so that it would not contribute significant illumination to the target.
- The bottom of the Teledyne Big Beam unit was located 7'-1", from the floor, comparable to the in-plant configuration.
- The Teledyne Big Beam unit was connected to AC power, with a fully charged battery, until the 8-hour illumination test was conducted.

- The Teledyne Big Beam unit was illuminated by pressing the test switch with AC power connected. The unit illuminated automatically with AC power removed.

- Discharge testing for the Teledyne Big Beam unit was conducted at 8-hours only, consistent with 10 CFR 50 Appendix R, Section III.J.

- Photos of component illuminating tests were taken from a tripod at similar locations and the same camera setting for each photo.

- A light meter (reading in foot-candle) was attached to the target.

- The model LX-1128SD light meter (Serial No. T016275) utilized has an accuracy of $\pm$ 4%. The light meter readings recorded in Tables E.7.1-2 through E.7.1-8, do not account for meter accuracy. See Attachment E.2 for light meter data and calibration certificate.

Table E.7.1-1, Lighting Tests Performed

Light Type	Test 1	Test 2	Test 3	Test 4	Test 5	Test 6	Test 7	Test 8	Test 9
Teledyne Big Beam	**1.A** Illumination of target at various distances (120 volt AC power provided)	**2.A** Illumination of target at various distances with Operator 2 ft. in front of Target (120 volt AC power provided)	N/A	N/A	**5.A** Illumination of procedure (120 volt AC power provided)	**6.A** Illumination of target at a distance of 5 and 10 ft. with battery discharged 8-hours	N/A	N/A	N/A
Fenix HM65R Headlamp Each individual lighting mode tested	N/A	N/A	**3.B** Illumination of target at various distances with rechargeable battery fully charged	**4.B** Illumination of target at various distances with rechargeable battery discharged 1.5 hours	Illumination of procedure **5.B.1** Rechargeable battery discharged at least 1.5 hours **5.B.2** CR123 batteries discharged for at least 1.5 hours	Illumination of target with rechargeable battery at distance of 5 and 10 ft. and battery discharged: **6.B.1** 8-hours **6.B.2** 16-hours (test conducted three separate times)	**7.B** Illumination of target at various distances with new CR123 batteries	**8.B** Illumination of target at various distances with CR123 batteries discharged 1.5 hours	**9.B** Illumination of target at a distance of 5 and 10 ft. with CR123 batteries discharged 8-hours
Underwater Kinetics UK4AA-AS2	N/A	N/A	**3.C** Illumination of target at various distances with new batteries	**4.C** Illumination of target at various distances with batteries discharged 1.5 hours	**5.C** Illumination of procedure with batteries discharged 1.5 hours	**6.C** Illumination of target at a distance of 5 and 10 ft. with batteries discharged 8-hours	N/A	N/A	N/A

Tables E.7.1-2 through E.7.1-8 provide the results of the lighting performance test for Teledyne Big Beam emergency light, a Fenix HM65R headlamp, and an Underwater Kinetics UK4AA-AS2 flashlight. The Underwater Kinetics flashlight has been approved for a peer Nuclear Plant by the NRC via a NFPA 805 license amendment request. The Underwater Kinetics UK4AA-AS2 model flashlight with hard hat clip was not selected for illuminating operator actions at Wolf Creek. The performance data was included as a comparison point for the portable lighting proposed by Wolf Creek and portable lighting that has been previously approved for a plant with a NFPA 805 licensing bases. Attachment E.3 provides the detailed product specifications for the Underwater Kinetics UK4AA-AS2 flashlight.

The illumination testing revealed the following:

- The Fenix HM65R headlamp with a rechargeable battery that has been continuously discharged on High Spotlight mode for a period of 16 hours provides superior illumination in all lighting modes, with the exception of Low Floodlight, when compared to a fully charged Teledyne Big Beam fixed emergency lighting unit comparable to those installed at Wolf Creek. This demonstrates that the Fenix HM65R headlamp will provide lighting levels for illuminating implementing procedures, safe shutdown equipment, and the respective access egress routes to the equipment that exceed those provided by fixed emergency lighting units.

- The Teledyne Big Beam fixed emergency lighting unit maximum illumination level was 3.8 foot-candles at 5 ft. from the target with a fully charged battery.

  Consistent with NUREG-0700 guidance for control room emergency illumination, the Fenix HM65R headlamp provides an illumination level greater than 10 foot-candles at a distance of 5 ft. from the target for the following configurations:

  - Rechargeable battery on Turbo Spotlight, High Spotlight, Medium Spotlight, or High Flood Light with a battery that has been discharged up to 16 hours on High Spotlight mode.

  - CR123 batteries on Turbo Spotlight, High Spotlight, Medium Spotlight, or High Flood Light with batteries that have been discharged up to 1.5 hours on High Spotlight mode.

- With an individual positioned directly in front of the target component, the Fenix HM65R headlamp provides significant illumination improvement of target component compared to the illumination provided by the fixed emergency light unit.

- The Fenix HM65R headlamp provided substantial illumination improvement of the procedure in hand when compared to the illumination provided by the fixed emergency lighting unit.

- The Fenix HM65R headlamp with disposable CR123 batteries did not perform as well from a runtime perspective when compared to rechargeable battery performance. This is expected since the capacity for the two series CR123 batteries is 1500 mAh compared to a 3500 mAh rating for the single rechargeable 18650 battery. Considering this, the CR123 battery will not be the primary battery source for normally daily use of the headlamps. However, due to its long storage life (approximately 10 years), CR123 / CR123A will be preferred battery for strategically staging in the plant for emergent battery replacement.

- The Fenix HM65R headlamp on Turbo Spotlight mode does provide superior lighting to the other lighting modes for the headlamp but at a sacrifice of reduced runtime. Considering this, it will be recommended that Operations personnel use either High Spotlight or High Floodlight illumination modes as the preferred illumination selections in an effort to optimize runtime performance while still realizing a high illumination output from the headlamp.

- When battery capacity for the Fenix HM65R headlamp does not support the selected illumination mode, the headlamp will automatically adjust to a lower illumination level that the battery can support. At its lowest performance level, the headlamp will switch to Low Floodlight mode. This transition can be used by the operator as an aid to signal that battery replacement is warranted. Additional informational testing (not documented in work order 21-468651-000) of the Fenix HM65R headlamp with a rechargeable battery revealed that the headlamp remained in the Turbo Spotlight illumination mode for over four hours. It ultimately switched to Low Floodlight mode where it continued to illuminate for more than eight hours. At Low Floodlight mode, as shown in Photo E.4.E-5, sufficient lighting is available to provide immediate travel path illumination. This provides reasonable assurance that an Operator should not be left in the dark with a significantly discharged headlamp battery.

- The Fenix HM65R headlamp performance was significantly superior to the Underwater Kinetics UK4AA-AS2 model flashlight in both illumination levels and battery run time.

Table E.7.1-2, Lighting Performance – Light Two (2) ft. from Target

Test #	Light Type	Battery Information	Illumination Level (foot-candle)						
			Turbo Spot (ft.-candle)	High Spot	Med Spot	Low Spot	High Flood	Med Flood	Low Flood
3.B	Fenix HM65R Headlamp	Rechargeable Battery Fully Charged	221.3	114.5	36.3	14.8	35.8	11.7	0.8
4.B		Rechargeable Battery Discharged 1.5 Hours[1]	224.1	116.1	36.6	14.9	36.6	11.9	0.8
7.B		New CR123 Batteries	222.2	116.7	37.1	15.2	32.7	10.7	0.7
8.B		CR123 Batteries Discharged 1.5 Hours[1]	220.4	119.1	37.9	15.8	33.5	11.0	0.7
3.C	Underwater Kinetics UK4AA-AS2	New AA Batteries	42.4						
4.C		AA Batteries Discharged 1.5 Hours	39.7						

Note:

1. Fenix HM65R headlamp battery was discharged on High Spotlight.

2. Teledyne Big Beam emergency lighting unit was not tested at 2 ft. distance, as fixed emergency lighting in the plant is not located within 2 ft. of components to be illuminated.

Table E.7.1-3, Lighting Performance – Light Five (5) ft. from Target

Test #	Light Type	Battery Information	Illumination Level (foot-candle)						
			Turbo Spot	High Spot	Med Spot	Low Spot	High Flood	Med Flood	Low Flood
3.B	Fenix HM65R Headlamp	Rechargeable Battery Fully Charged	116.6	64.3	20.4	8.3	17.9	5.8	0.3
4.B		Rechargeable Battery Discharged 1.5 Hours[1]	116.9	63.9	20.4	8.3	17.8	5.8	0.3
6.B.1		Rechargeable Battery Discharged 8 Hours[1]	105.4	57.6	18.2	7.5	17.2	5.4	0.3
6.B.2 #1		Rechargeable Battery Discharged 16 Hours[1]	108.4	58.2	18.5	7.6	17.4	5.5	0.3
6.B.2 #2		Rechargeable Battery Discharged 16 Hours[1]	109.0	65.5	20.8	8.5	18.7	5.9	0.3
6.B.2 #3		Rechargeable Battery Discharged 16 Hours[1]	107.5	63.7	20.4	8.3	18.6	5.9	0.3
7.B		New CR123 Batteries	119.1	63.0	20.1	8.2	17.2	5.6	0.3
8.B		CR123 Batteries Discharged 1.5 Hours[1]	114.4	61.9	19.4	7.9	16.9	5.5	0.3
9.B		CR123 Batteries Discharged 8 Hours[1]	Note 2	Note 2	Note 2	Note 2	Note 2	Note 2	0.3
3.C	Underwater Kinetics UK4AA-AS2	New AA Batteries	27.9						
4.C		AA Batteries Discharged 1.5 Hours	23.6						
6.C		AA Batteries Discharged 8 Hours	Note 3						
1.A	Teledyne Big Beam	Battery on AC Power	3.8						
6.A		Battery Discharged 8 Hours	2.6						

Notes:

1. Fenix HM65R headlamp battery was discharged on High Spotlight.

2. At some point during the eight hours of discharge on High Spotlight mode, the Fenix HM65R headlamp automatically transferred to Low Flood Light mode due to low battery capacity. The values recorded for 8-hour test results were all with the Fenix HM65R headlamp on Low Flood Light mode. Based on results of 8-hour testing, no testing was conducted with the CR123 batteries for a 16 hour discharge duration.

3. Between hour 6 and 7 of discharge, the battery capacity for the Underwater Kinetics UK4AA-AS2 flashlight was depleted.

Table E.7.1-4, Lighting Performance – Light Ten (10) ft. from Target

Test #	Light Type	Battery Information	Illumination Level (foot-candle)						
			Turbo Spot	High Spot	Med Spot	Low Spot	High Flood	Med Flood	Low Flood
3.B	Fenix HM65R Headlamp	Rechargeable Battery Fully Charged	34.4	19.2	6.1	2.5	5.6	1.8	0.0
4.B		Rechargeable Battery Discharged 1.5 Hours[1]	35.8	19.5	6.2	2.5	5.6	1.7	0.0
6.B.1		Rechargeable Battery Discharged 8 Hours[1]	34.8	19.3	6.1	2.5	6.0	1.8	0.0
6.B.2 #1		Rechargeable Battery Discharged 16 Hours[1]	33.1	18.8	6.0	2.4	5.8	1.8	0.0
6.B.2 #2		Rechargeable Battery Discharged 16 Hours[1]	35.3	19.9	6.3	2.6	6.3	1.9	0.0
6.B.2 #3		Rechargeable Battery Discharged 16 Hours[1]	33.2	19.9	6.1	2.5	6.1	1.8	0.0
7.B		New CR123 Batteries	36.1	18.9	6.0	2.5	5.7	1.8	0.0
8.B		CR123 Batteries Discharged 1.5 Hours[1]	35.3	18.9	6.0	2.4	5.8	1.8	0.0
9.B		CR123 Batteries Discharged 8 Hours[1]	Note 2	Note 2	Note 2	Note 2	Note 2	Note 2	0.0
3.C	Underwater Kinetics UK4AA-AS2	New AA Batteries	6.4						
4.C		AA Batteries Discharged 1.5 Hours	4.2						
6.C		AA Batteries Discharged 8 Hours	Note 3						
1.A	Teledyne Big Beam	Battery on AC Power	1.4						
6.A		Battery Discharged 8 Hours	1.3						

Notes:

1. Fenix HM65R headlamp battery was discharged on High Spotlight.
2. At some point during the eight hours of discharge on High Spotlight mode, the Fenix HM65R headlamp automatically transferred to Low Flood Light mode due to low battery capacity. The values recorded for 8-hour test results were all with the Fenix HM65R headlamp on Low Flood Light mode. Based on results of 8-hour testing, no testing was conducted with the CR123 batteries for a 16-hour discharge duration.
3. Between hour 6 and 7 of discharge, the battery capacity for the Underwater Kinetics UK4AA-AS2 flashlight was depleted.

Table E.7.1-5, Lighting Performance – Light Fifteen (15) ft. from Target

Test #	Light Type	Battery Information	Illumination Level (foot-candle)						
			Turbo Spot	High Spot	Med Spot	Low Spot	High Flood	Med Flood	Low Flood
3.B	Fenix HM65R Headlamp	Rechargeable Battery Fully Charged	18.4	9.7	3.0	1.3	2.8	0.9	0.0
4.B		Rechargeable Battery Discharged 1.5 Hours[1]	18.3	9.9	3.1	1.3	2.8	0.9	0.0
7.B		New CR123 Batteries	18.2	9.3	3.0	1.3	2.9	0.9	0.0
8.B		CR123 Batteries Discharged 1.5 Hours[1]	17.8	9.5	2.9	1.2	2.7	0.9	0.0
3.C	Underwater Kinetics UK4AA-AS2	New AA Batteries	4.3						
4.C		AA Batteries Discharged 1.5 Hours	2.9						
1.A	Teledyne Big Beam	Battery on AC Power	0.8						

Note:
1. Fenix HM65R headlamp battery was discharged on High Spotlight.

Table E.7.1-6, Lighting Performance – Light Twenty (20) ft. from Target

Test #	Light Type	Battery Information	Illumination Level (foot-candle)						
			Turbo Spot	High Spot	Med Spot	Low Spot	High Flood	Med Flood	Low Flood
3.B	Fenix HM65R Headlamp	Rechargeable Battery Fully Charged	10.6	5.6	1.7	0.7	1.7	0.5	0.0
4.B		Rechargeable Battery Discharged 1.5 Hours[1]	10.6	5.8	1.8	0.7	1.7	0.5	0.0
7.B		New CR123 Batteries	10.4	5.5	1.7	0.7	1.7	0.5	0.0
8.B		CR123 Batteries Discharged 1.5 Hours[1]	9.7	5.3	1.6	0.6	1.6	0.5	0.0
3.C	Underwater Kinetics UK4AA-AS2	New AA Batteries	2.4						
4.C		AA Batteries Discharged 1.5 Hours	1.7						
1.A	Teledyne Big Beam	Battery on AC Power	0.5						

Note:
1. Fenix HM65R headlamp battery was discharged on High Spotlight.

Table E.7.1-7, Lighting Performance - Procedure Illumination Level

Test #	Light Type	Battery Information	Illumination Level (foot-candle) Standing in Front of Target						
			Turbo Spot	High Spot	Med Spot	Low Spot	High Flood	Med Flood	Low Flood
5.B.1	Fenix HM65R Headlamp	Rechargeable Battery Discharged 1.5 Hours[1]	690.0	383.1	124.8	51.7	108.6	35.4	2.5
5.B.2		CR123 Batteries Discharged 1.5 Hours[1]	647.2	348.7	113.3	47.0	107.6	35.6	2.5
5.C	Underwater Kinetics UK4AA-AS2	AA Batteries Discharged 1.5 Hours	72.1						
5.A	Teledyne Big Beam	Battery on AC Power	0.0						

Note:
1. Fenix HM65R headlamp battery was discharged on High Spotlight.

Table E.7.1-8, Lighting Performance – Teledyne Big Beam Target Illumination Level with Operator in Front of Target

Test #	Light Type	Battery Information	Distance Light from Target (ft.)	Test 5.A Procedure Illumination Level (foot-candle)
2.A	Teledyne Big Beam	Battery on AC Power	5	0.0
			10	0.0
			15	0.0
			20	0.0

E.7.2 Operations' Assessment

In an effort to solicit feedback from Operations regarding their opinion of the portable lighting and its use as the primary emergency lighting method for illuminating operator manual actions, the portable lighting equipment discussed in E.6 was provided to multiple Operators for in plant use. Feedback received was positive for the Fenix HM65R headlamp assembly.

E.8 Preventive Maintenance Activities

E.8.1 The Fenix HM65R headlamp assembly will be standard issue to all on shift Operations personnel responsible for manipulating plant equipment. It will be attached to their hard hat and used in situations where plant activities require additional illumination to safely perform their job function. Each Operator will be responsible for proper operation and upkeep of the headlamp, including battery charge status and battery replacement. Information regarding headlamp responsibilities and upkeep will be provided in a Standing Order, Desktop Instruction, or equivalent. There will be no formal PM for the individual headlamps issued to Operations personnel.

E.8.2 AP 21-001, *Conduct of Operations*

Attachment H, Start of Shift Crew Briefing

This Attachment is utilized by the Control Room Supervisor (CRS) to ensure a consistent crew briefing at the beginning of the shift. It has been revised to include a step for the CRS to ensure that Operators assigned OFN RP-017, OFN KC-016, EMG C-0, and/or OFN NB-034 manual action responsibility to confirm acceptable function of their headlamp and that it is indicating a charged condition (four battery level indication lights on) at the beginning of the shift. Typically, rechargeable batteries will be utilized during daily operation considering their increased run time, and to limit the amount of waste associated with the use of disposable batteries.

E.8.3 Spare Portable Lights and Batteries

Sufficient replacement batteries and spare portable headlamps are strategically located in the plant, and periodically inventoried, to ensure that a minimum eight hours of portable lighting is available for Operations staff personnel responsible for the manipulation of safe shutdown equipment. Specifically, the following emergency equipment lockers in the plant are equipped with at least three (3) Fenix HM65R headlamps and at least six (6) sets of CR123 / CR123A batteries (12 total batteries). The equipment in the lockers is inspected and inventoried in accordance with STN GP-009, *Emergency Equipment Verification*.

- Auxiliary Building 2026' – Aux Shutdown Panel Locker
- Auxiliary Building 2026' – South Electrical Penetration Room Locker
- Control Building 2000' – 'B' ESF Switchgear Room Locker
- Turbine Building 2033' Locker

Additional Fenix HM65R headlamps, rechargeable batteries, charging station, and CR123 / CR123A batteries are located in the Work Control Center area across from the Control Room.

E.9 Defense-In-Depth

E.9.1 8-Hour Fixed Emergency Lights That Remain in Safe Shutdown Strategy

As identified in Section E.2.5, fixed emergency lighting units with 8-hour battery capacity for the Control Room, Auxiliary Shutdown Panel, and emergency diesel generator control panel areas will continue to be credited in the emergency lighting illumination response strategy for safe shutdown. This is in recognition that these areas may warrant continuous manning in response to potential postulated events, such as fire or loss of offsite power. It is prudent to retain the current emergency lighting strategy for these areas in an effort to promote human factoring, since there are many indications and controls in these areas that require Operator attention. Additionally, the emergency lighting unit illuminating the Operation's hard hat rack just outside the Control Room will be credited as an 8-hour emergency light to ensure illuminated access/egress for Control Room personal to obtain their hard hats, containing the Fenix HM65R headlamp.

E.9.2 Fixed Emergency Lights That Are Being Downgraded

With limited exception, the fixed emergency lighting (excluding Table E.2.5-1) that was previously credited for illuminating operator manual actions will remain installed within the plant. The E-1L8900 identified head lamp aiming positions will be retained. However, this fixed emergency lighting, which will be treated comparable to life safety emergency lighting from a battery life (1.5 hours) and preventive maintenance perspective, is considered supplemental to portable lighting. This lighting and the remaining 1.5-hour fixed emergency lighting will support firefighting efforts and life safety access/aggress.

E.9.3 OFN RP-017, Control Room Evacuation

This procedure provides the Operator actions for evacuating the Control Room due to fire. OFN RP-017 contains steps for each Operator implementing the procedure to obtain a spare set of CR123 / CR123A batteries strategically located in field emergency lockers discussed in Section E.8.3 of this Attachment. A step has also been included at the completion of OFN RP-017 Attachment D for the Operator performing the Auxiliary Building actions to obtain spare Fenix HM65R headlamps and CR123 / CR123A batteries as necessary from the available locations discussed in Section E.8.3 to distribute to the Operations team. This will allow future refresh of portable lighting if necessary.

E.9.4 Photoluminescent Labels

All OMAs outside the Control Room that are required for PFSSD are provided with a photoluminescent label as shown in Figures E.9.4-1 and E.9.4-2. The purpose of the labels is to improve the identification and response time for locating PFSSD equipment/components during potential plant fire scenarios when normal lighting has failed. Change package 012523 approved the use of the labels for identification of PFSSD components. The change package also conducted performance testing of the labels to assess their illumination capability. The change package concluded that the labels will be an aid to Operators in locating PFSSD equipment, especially in a low light situation.

Figure E.9.4-1, Photoluminescent Label (Normal Lighting)

Figure E.9.4-2, Photoluminescent Label (Normal Lighting Off)

E.10 Feasibility and Reliability Analysis

E.10.1 Operator Manual Actions in Response to Fire

NUREG-1852 defines feasible action as:

> *An action that is analyzed and demonstrated as being able to be performed within an available time so as to avoid a defined undesirable outcome. As compared to a reliable action (see definition), an action is considered feasible if it is shown that it is possible to be performed within the available time (considering relevant uncertainties in estimating the time available); but it does not necessarily demonstrate that the action is reliable. For instance, performing an action successfully one time out of three attempts within the available time shows that the action is feasible, but not necessarily reliable.*

NREG-1852 defines reliable action as:

> *A feasible action that is analyzed and demonstrated as being dependably repeatable within an available time, so as to avoid a defined adverse consequence, while considering varying conditions that could affect the available time and/or the time to perform the action. As compared to an action that is only feasible (see definition), an action is considered to be reliable as well if it is shown that it can be dependably and repeatably performed within the available time, by different crews, under somewhat varying*

conditions that typify uncertainties in the available time and the time to perform the action, with a high success rate. All reliable actions need to be feasible, but not all feasible actions will be reliable.

Lighting is an environmental factor that could negatively impact the ability to perform operator actions, as such it needs be considered when assessing the acceptability of manual actions.

E-1F9900 (approved via License Amendment 191) documents the feasibility and reliability of operator manual actions, considering NUREG-1852, for a fire outside the Control Room. The evaluation identifies six distinct operator actions. These actions are implemented by OFN KC-016, *Fire Response*. Fire Area A-16 has the longest, bounding manual action timeline. Considering time allotments for fire indicated, diagnosis, performance of manual action, and uncertainty, the analyzed timeline for OMA performance is 67 minutes with 27 minutes required for the actual field performance of the operator actions. Applying the full OMA assigned uncertainty time of 26 minutes results in 53 minutes that emergency lighting would be required to illuminate the egress path, procedure, and safe shutdown equipment.

E-1F9915 (approved via License Amendment 214) documents the step by step analysis of operator manual actions, considering 10 CFR 50 Appendix R, for a Control Room fire. This analysis provides the timing bases demonstrating that the PFSSD functions (Reactivity Control, Reactor Coolant Makeup and Inventory Control, Decay Heat Removal, Process Monitoring and Support) are satisfied prior to reaching unrecoverable conditions. These steps are implemented by OFN RP-017, *Control Room Evacuation*. The procedure is divided into attachments with different Operator's having the responsibility of completing their assigned attachment. The Attachments supporting post-fire safe shutdown are coordinated during implementation. Required action time limits are 67 minutes or less, with the exception of isolating the RWST to the safety injection test header, which has a 71 hour time limit.

Periodic performance timing of the manual actions required to achieve and maintain PFSSD per OFN KC-016 and OFN RP-017 is performed by Operations personnel in accordance with AI 21-017, *Timed Fire Protection Actions Validation*. This timing validation by multiple personnel demonstrates overall manual action feasibility and reliability from a performance perspective. The portable lighting supports acceptable feasibility based on the following:

- The illumination tests document in Section E.7 reflect that the Fenix HM65R headlamp provides superior lighting, when compared to Teledyne Big Beam, for illumination of procedure, safe shutdown equipment, and egress pathways.

- Performance demonstrations per AI 21-017 reflect that the manual actions supporting OFN KC-016 or OFN RP-017 implementation are accomplished

in under an hour which is well within the battery capacity of the portable lighting.

- The photoluminescent component labels discussed in Section E.9.4 aid in Operator identification of post-fire safe shutdown equipment. This minimizes time required to locate equipment for manipulation.

There are no other environmental factors (radiation, temperature, humidity, smoke, toxic gas, or noise) that negatively impact the ability to perform operator manual actions at Wolf Creek, as Operators will not have to traverse through the event area to perform OMAs. Additionally, the Fenix HM65R headlamp is IP68 rated (dust-proof and waterproof - fully submersible to 6.5 feet for 30 minutes) per ANSI/IEC 60529. This ensures protection of the headlamp during normal daily use.

Reliability of the emergency portable lighting is ensured by the periodic maintenance activities discussed in Section E.8 coupled with the spare portable lighting and batteries available at multiple emergency equipment locker locations. This ensures that sufficient portable lighting will be available for more than 8-hours following the onset of a fire event that renders normal lighting and standby lighting unavailable.

E.10.2 Operator Manual Actions in Response to a Non-Fire Event

The previously discussed Fenix HM65R headlamp being used for OMAs in response to fire conditions is also adequate as the primary emergency lighting option for non-fire event conditions warranting Operator action outside the Control Room.

E.11 Future Evaluation of Equivalent Portable Lighting

It is recognized that obsolescence challenges and future advancements in portable lighting and batteries may result in a desire to utilize equivalent replacement portable lighting and/or batteries in lieu of the models discussed in this Attachment. The portable lighting and batteries identified in this Attachment are considered tools. Typically, a tool is not controlled by design configuration. However, considering the importance of this portable lighting in the support of safe shutdown, a hybrid approach will be used to control the use of equivalent replacement portable lighting models and batteries. The evaluation of equivalent replacement portable lighting and batteries may be conducted without revision to this Attachment provided the review is documented in a work order (or equivalent) and addresses the following attributes:

Headlamp

The headlamp shall satisfy the following:

- Attach to the hard hat via non-slip strap, elastic strap with helmet clips, or an adhesive headlamp attachment
- Dual LED light (both spot and flood) with Low Medium and High light outputs
- Adjustable tilt head
- Minimum illumination rating on High Spotlight – 400 Lumens
- Minimum illumination rating on High Floodlight – 400 Lumens
- Minimum run time rating on High Spotlight – 16 hours
- Minimum run time rating on High Floodlight – 16 hours
- Maximum Weight (excluding battery) – 8 ounces
- Minimum Ingress Protection (IP) rated IP68 per ANSI/IEC 60529
- Conforms to ANSI/PLATO FL 1 or UL S8001

Battery

The battery requirements for the Fenix HM65R headlamp are per Table E.11-1.

Table E.11-1, Battery Requirements

Item #	Parameter	Rechargeable 18650	CR123 / CR123A
1	Type	Lithium-ion or equivalent with: 1) protection circuitry to prevent short circuit, over charge, over discharge, and overheating 2) Pressure relief venting	Lithium or Alkaline (Two required)
2	Nominal Voltage	3.6 volts	3.0 volts
3	Capacity	3400 mAh or greater	1500 mAH or greater
4	Charging Cycles	500 or more at up to 75% capacity	N/A
5	Independent Testing	Conforms to UN38.3 (Reference E.15.44) or equivalent	N/A

Batteries for the Fenix HM65R headlamp shall satisfy the requirements of Table E.11-1. For an alternate headlamp to the Fenix HM65R, rechargeable batteries shall be compatible with the headlamp assembly of choice, provide the circuit protection, pressure relief venting, charging cycles, and independent testing required for Items 1 and 5 respectively from Table E.11-1.

In the event the criteria above are not met for the proposed alternative replacement portable light or battery, it shall either be rejected, or this Attachment revised to address the

acceptability of the differences associate with the alternative portable lighting and/or battery.

E.12 Maintenance Rule Application

As previously identified, the fixed emergency lighting identified in Table E.2.5-1, will continue to be credited for illumination of safe shutdown operator actions. Considering this, these emergency lighting units will also continue to be scoped within the 10 CFR 50.65 Maintenance Rule Program implemented by Wolf Creek per procedure AP 23M-001. The fixed emergency lighting that is being downgraded will no longer be scoped within the Maintenance Rule, as it is no longer relied upon to mitigate an accident or transient described in the USAR, nor is it used in the emergency response procedures to provide accident mitigation. The portable lighting credited as the primary emergency lighting means for illuminating safe shutdown operator actions will not be included in Maintenance Rule scope considering that this lighting is considered a tool and is readily replaceable, and the preventive maintenance strategy is a simplistic approach comprised of periodic inventory checks, lighting checks, and battery replacement. The Fenix HM65R headlamp is credited as the compensatory measure for Table E.2.5-1 fixed emergency lighting when it is deficient or nonfunctional.

E.13 Precedent

There are plants (References E.15.37 and E.15.38 for example) who have transitioned to a NFPA 805 license bases and now credit portable lighting as the primary emergency lighting means for illuminating operator manual actions. Wolf Creek continues to maintain a deterministic fire protection license bases, with no plans to transition to NFPA 805. As discussed in E.3, the justification approach for the use of portable lighting as a primary means for illuminating safe shutdown equipment is similar for both the deterministic and risk informed fire protection license bases in that feasibility and reliability are the key elements that warrant methodical assessment. Additionally, Table E.13-1 identifies instances where the NRC has approved previous requests for alternative emergency lighting approaches (flashlights) in lieu of direct compliance with 10 CFR 50 Appendix R Section III.J.

Table E.13-1, NRC Approved Exemption Requests Crediting Portable Lighting

Accession No.	Date	Subject	Discussion
ML013460187	11/06/1986	North Anna, Units 1 & 2, Exemption, Relating to Letters Requesting Thirty-Four Exemptions from Appendix R to 10 CFR Part 50	Approved the use of portable lighting in Seal Water Filter Areas and transition through outside areas
ML003765204	12/30/1986	Three Mile Island, Unit 1, Exemption Regarding Fire Protection	Approved the use of portable lighting in Containment
ML020290207	12/30/1986	Brunswick Units 1 &2 Exemption from Requirements of Appendix R to 10 CFR 50, Section III.G and J	Approved the use of portable lighting for transition through the East Yard and reading gauges
ML091310132	07/27/1987	Beaver Valley Power Station, Unit No. 1 - Transmittal of Appendix R Technical Exemption Regarding Emergency Lighting	Approved use of portable lighting to enhance permanently installed 8-hour emergency lighting for the following: Intake Structure, Turbine Deck, Primary Auxiliary Building, Service Building Roof Top to Feedwater Regulating Valve Room, Normal 4-kv Switchgear Room, AE and DF Emergency Switchgear Rooms, Process Rack Room
ML020530077	07/30/1987	HB Robinson Unit 2, Exemptions from Certain Requirements of 10 CFR 50, Appendix R, Section III.J	Approved use of portable lighting for certain paths to Charging Pump Room, Component Cooling Water Heat Exchanger Room, DC Distribution Panels in the Battery Room and Safety Injection Pump Room
ML012670091	02/25/1988	Approval of Technical Exemption Requests from Appendix R, 10 CFR Part 50 for Surry Power Station	Approved the use of portable lighting in Containment and transition through outside areas

E.14 Conclusion

Considering the superior illumination levels provided by the Fenix HM65R headlamp in comparison to the Teledyne Big Beam emergency lighting unit, the procedure implementation duration, the battery life of the portable emergency lighting, the strategy for ensuring battery charge level at the beginning of a shift, and the strategic location of spare headlamps and disposable CR123 / CR123A batteries in the plant, adequate illumination will be provided by the Fenix HM65R headlamp for the performance of OMAs in support of safe shutdown from either a fire or an event resulting in the loss of all AC power. The portable lighting described in this evaluation is acceptable as the primary emergency lighting methodology for a diverse emergency lighting strategy that includes the following:

- 8-hour fixed battery units for the locations that may require long term attendance in support of safe shutdown.
- Portable (hard hat mounted) lighting for illuminating safe shutdown implementing procedures, equipment, and the access egress routes to the equipment.
- 1.5-hour fixed battery units for firefighting activities, life safety access/egress, and supplementary lighting to portable lighting.

E.15 References

E.15.1 E-1F9900, Post-Fire Safe Shutdown Operator Manual Actions, Rev. 10

E.15.2 OFN KC-016, Fire Response, Rev. 51

E.15.3 Correspondence 10-00711, Wolf Creek Generating Station -Issuance of Amendment Re: Deviation From Fire Protection Program Requirements [License Amendment 191 for E-1F9900], dated December 16, 2010

E.15.4 E-1F9915, Design Basis Document for OFN RP-017, Control Room Evacuation, Rev. 14

E.15.5 OFN RP-017, Control Room Evacuation, Rev. 54

E.15.6 Correspondence 15-00793, Wolf Creek Generating Station - Issuance of Amendment Re: Revise The Fire Protection Program Related to Alternative Shutdown Capability [License Amendment 214 for E-1F9915], dated September 11, 2015

E.15.7 USAR Section 9.5.3.2.3, Emergency Lighting System, Rev. 27

E.15.8 USAR Section 7.4, Systems Required for Safe Shutdown, Rev. 14

E.15.9 NFPA 805, Performance-Based Standard for Fire Protection for Light Water Reactor Electric Generating Plants, 2001 Edition

E.15.10 EPRI TR-106826, Battery Performance Monitoring by Internal Ohmic Measurements – Emergency Lighting Unit Batteries, dated December 1996

E.15.11 10 CFR 50 Appendix R, Fire Protection Program for Nuclear Power Facilities Operating Prior to January 1, 1979

E.15.12 Regulatory Guide 1.189, Fire Protection for Nuclear Power Plants, Rev. 4

E.15.13 NUREG-0800, Standard Review Plan Section 9.5.3, Lighting Systems, Revision 3

E.15.14 NUREG-0700, Human-System Interface Design Review Guidelines, Rev. 3

E.15.15 NUREG-1852, Demonstrating the Feasibility and Reliability of Operator Manual Actions in Response to Fire, publish dated October 2007

E.15.16 NFPA 101, Life Safety Code, 2021 Edition

E.15.17 Change Package 20283, Portable Lighting for Operator Manual Actions, Rev. 0

E.15.18 Work Order 21-468651-000, Portable Lighting Performance Test

E.15.19 AP 21-001, Conduct of Operations, Rev. 86

E.15.20 STN GP-009, Emergency Equipment Verification, Rev. 81B

E.15.21 Change package 012523, PFSSD Label Enhancement Project, Rev. 0

E.15.22 E-1L8900, Lighting Notes, Symbols and Details, Rev. 89

E.15.23 AP 23M-001, WCGS Maintenance Rule Program, Rev. 13

E.15.24 ANSI/IEC 60529, Degrees of Protection Provided by Enclosures (IP Code) 2020 Edition

E.15.25 10 CFR 50.65, Requirements for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants

E.15.26 NRC Accession No. ML013460187, North Anna, Units 1 & 2, Exemption, Relating to Letters Requesting Thirty-Four Exemptions from Appendix R to 10 CFR Part 50, dated 11/06/1986

E.15.27 NRC Accession No. ML003765204, Three Mile Island, Unit 1, Exemption Regarding Fire Protection, dated 12/30/1986

E.15.28 NCR Accession No. ML020290207, Brunswick Units 1 &2 Exemption from Requirements of Appendix R to 10 CFR 50, Section III.G and J, Pertaining to Fire Protection of Safe Shutdown Capability and Emergency Lighting for Safe Shutdown Capability, dated 12/30/1986

E.15.29 NRC Accession No. ML091310132, Beaver Valley Power Station, Unit No. 1 – Transmittal of Appendix R Technical Exemption Regarding Emergency Lighting, dated 07/27/1987

E.15.30 NRC Accession No. ML020530077, HB Robinson Unit 2, Exemptions from Certain Requirements of 10 CFR 50, Appendix R, Section III.J, dated 07/30/1987

E.15.31 NRC Accession No. ML012670091, Approval of Technical Exemption Requests from Appendix R, 10 CFR Part 50 for Surry Power Station dated 02/25/1988

E.15.32 Wolf Creek Fire Protection Program Regulatory Bases, Rev. 4

E.15.33 LER 95-005, Failure To Develop Adequate Fire Protection Program Emergency Lighting, dated 10/05/1995

E.15.34 EMG C-0, Loss of All AC Power, Rev. 45A

E.15.35 OFN NB-034, Loss of All AC Power – Shutdown Conditions, Rev. 33

E.15.36 NUREG 0881 Vol. 1 - Safety Evaluation Report Related to The Operation of Wolf Creek Generating Station Unit No. 1

E.15.37 Correspondence 22-00015, Cooper NFPA 805 Portable Lighting Information, dated 09/21/2022

E.15.38 Correspondence 22-00016, Callaway NFPA 805 Portable Lighting Information, dated 01/12/2022

E.15.39 Correspondence 22-00042, Fenix Lighting for Extremes Vendor Data, dated 02/08/2022

E.15.40 Correspondence 22-00045, Fenix Lighting Email - USB Charging Port for HM65R Headlamp, dated 02/11/2022

E.15.41 ANSI/PLATO FL 1, Flashlight Basic Performance Standard, 2019 Edition

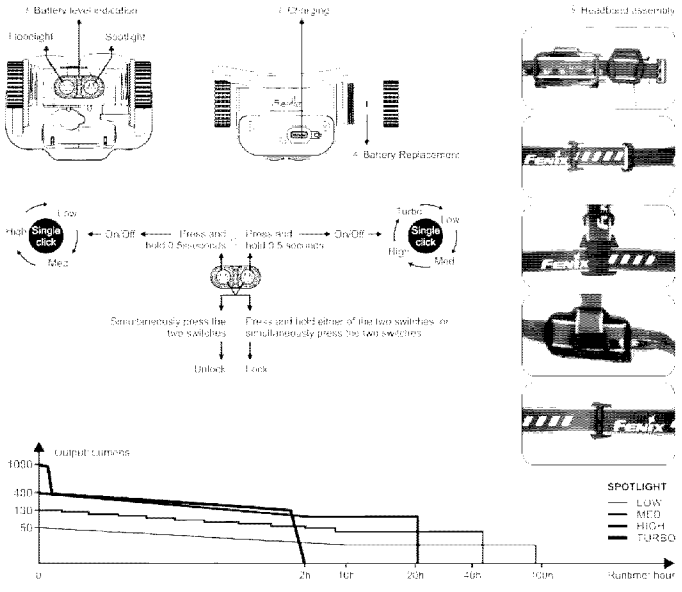
E.15.42 Correspondence 22-00067, UN38.3 Test Report for Fenix Lighting Battery ARB-L18-3500, dated 02/26/2015

E.15.43 Correspondence 22-00071, UN38.3 Test Report for Fenix Lighting Battery ARB-L18-3400, dated 03/28/2016

E.15.44 Recommendations on the Transport of Dangerous Goods, Manual of Tests and Criteria, [United Nations document], Sixth Edition

E.15.45 NRC Accession No. ML22011A086, Summary of January 10, 2022, Pre-Submittal Teleconference with Wolf Creek Nuclear Operating Corporation Regarding a License Amendment Request to Use Portable Lighting for Wolf Creek Generating Station, Unit 1 (EPID L-2021-LRM-0118), dated 01/11/2022

Attachment E.1, Fenix HM65R Headlamp Product Data (Page 1 of 7)



(English)Fenix HM65R Headlamp

- Spot and floodlight for various lighting demands
- Cree white and neutral white LED with a lifespan of 50,000 hours
- Powered by one 18650 rechargeable Li-ion battery or two 3V/CR123A batteries
- Constant current circuit guarantees longer runtime
- Dual tap switches for easy and fast operation
- Type C charging, 1.5A large current
- Quality aluminum, magnesium and PC material, lightweight and durable
- Tough tempered ultra-clear glass lens with anti-reflective coating
- 3.17" x 2.17" x 1.57" (80.5 x 55 x 40 mm)
- 3.42 oz (97 grams) (excluding battery)

Operating Instruction ①

Switches
Spotlight: for on/off, mode switching, lockout function and output selection on spotlight mode.
Floodlight: for on/off, mode switching, lockout function and output selection on floodlight mode.

On/off
Press and hold either of the two switches for 0.5 seconds to turn on/off the lamp. Mod output level is set by default for first use. Afterwards, the light memorizes the last selected output. When turned on again the previously used output will be recalled.

Mode switching
Press and hold either of the two switches for 0.5 seconds to reach the corresponding mode.

Output selection
Spotlight mode: For the first use, single click the spotlight switch to cycle through Mid→High→Turbo→Low. Afterwards, the light memorizes the last selected output.
Floodlight mode: For the first use, single click the floodlight switch to cycle through Mid→High→Low. Afterwards, the light memorizes the last selected output.

Lockout Function
Lock: With the lamp switched off, press and hold either of the two switches, or simultaneously press the two switches for 3 seconds, the lamp will blink 3 times on Low of floodlight mode to indicate locked status.
Unlock: With the lamp is locked, simultaneously press the two switches for 3 seconds, the lamp will be activated with 4 one-second blinks and activates on Low of floodlight mode.
In locked states, clicking or pressing the switches will activate 4 one-second blinks to indicate locked status.

Specifications

ANSI/PLATO FL1	SPOTLIGHT MODE				FLOODLIGHT MODE		
	TURBO	HIGH	MED	LOW	HIGH	MED	LOW
OUTPUT	1000 lumens	450 lumens	100 lumens	50 lumens	400 lumens	100 lumens	8 lumens
RUNTIME	2 hours	22 hours	48 hours	97 hours	21 hours	50 hours	380 hours
DISTANCE	163 meters	101 meters	97 meters	37 meters	95 meters	30 meters	6 meters
INTENSITY	6,677 candelas	2,600 candelas	833 candelas	350 candelas	762 candelas	229 candelas	9 candelas
IMPACT RESISTANCE	2 meters						
WATERPROOF	IP68, 2 meters underwater						

▲ Test condition: Uses one Fenix ARB-L18-3500 rechargeable Li-ion battery at a temperature of 21±3°C with the flashlight between 50% - 80% relative humidity. The runtime of battery life cumulative time, when overheat protection active.

Charging ②

Operation
1. Unscrew the anti-dust cap and plug the USB Type-C side of the charging cable into the charging port of the lamp.
2. The normal charging time of the Fenix ARB-L18-3500 rechargeable Li-ion battery is about 3 hours with the lamp being switched off. When charging, Mid output or spotlight or floodlight mode can be separately selected. The light will not automatically power on after full charging.
3. In charging process, one indicator flashes below 25%, one constant-out and one flashes 25%-50%, two constant-on and one flashes 51%-75%, three constant-on and one flashes 76%-99%, four constant-on charging completed.
4. Replace the anti-dust cap to ensure waterproof and dustproof ability.

Battery Level Indication ③

With the lamp switched off, single click either switch to check the battery status. Single click momentarily the lamp will turn on momentarily, or without any operation the status will last for 3 seconds. There will be no response with the lamp locked.
Four lights on: 100% - 61%
Three lights on: 60% - 41%
Two lights on: 40% - 21%
One light on: 20% - 11%
One light flashes: 10% - 0%

Battery Replacement ④

Unscrew the battery cover anticlockwise to insert the battery with the anode side (+) towards the , then screw the battery cover back on.

Low Voltage Warning

When the battery level is detected (while) for currently used output, one of the indicator will flash to remind. Replace the battery or recharge the lamp as soon as possible.

Battery Specifications

Type	Dimensions	Nominal voltage	Usability	
Fenix ARB-L18 Series	18650	3.6 V/ 3.7 V	Recommended	
Non-rechargeable Battery (Li-ion)	CR123A	3V	Usable	
Rechargeable Battery (Li-ion)	16340	3.6 V/ 3.7 V	Banned	
Rechargeable Battery (Li-ion)	18650	3.6 V/ 3.7 V	Caution*	
Rechargeable Battery (Li-ion)	16340	3.2V	Banned	
Rechargeable Battery (LiFePO4)	18650	3.2V	Banned	

*18650 Li-ion batteries are downsize cells designed for commercial applications and must be treated with caution and handled with care. Only use quality batteries with circuit protection to reduce the potential for overheating or explosion, cell rob cutting or short circuiting are potentially risks the user assumes.
Quality Li-ion battery with protective circuit will reduce risks. Fenix ARB-L18 Series battery is recommended.

Headband Assembly ⑤

Notice: The headband is factory assembled by default.
1. Adjust the headband to the headlamp as shown (1 & 1'), by first sliding the hard cover to the bottom of the strap. Then, route the rear edge under the top slot.
2. Adjust the headband by sliding the buckle to required length.
3. Assemble top headband to better fix the headlamp. First fix the headband mount to the headband, route the one side of the top headband to the headband holder, and the other end to the top headband mount.

Usage and Maintenance

- Disassembling the sealed head can cause damage to the lamp and will void the warranty.
- Fenix recommends using an excellent quality Fenix 18650 battery.
- If the lamp will not be used for an extended period, remove the battery, or the lamp could be damaged by electrolyte leakage.
- Long term use can result in O-ring wear. To maintain a proper water seal, replace the ring with an approved spare.
- Periodic cleaning of the battery contacts may keep the lamp's performance as daily contacts may cause the lamp to flicker, shine intermittently or even fail to illuminate for the following reasons:

A. The battery needs replacing.
Solution: Replace battery. Ensure battery is inserted according to the manufacturer's specifications.
B. The threads, PCB board contact or other contacts are dirty.
Solution: Clean the contact points with a cotton swab soaked in rubbing alcohol.

If the above methods don't work, please contact the distributor.

Included

1*HM65R Headlamp, ARB-L18-3500 rechargeable Li-ion battery, 1 headband, 1 top headband, 1 headband mount, 1 Spare O-ring, 1 Charging cable, User manual, Warranty card.

⚠ Warning

The flashlight is a high-intensity lighting device capable of causing eye damage to the user or others. Avoid shining the lamp directly into anyone's eyes.

Attachment E.1, Fenix HM65R Headlamp Product Data (Page 2 of 7)

FENIX SEE WHAT MATTERS™ www.fenixlighting.com

NEW PRODUCT ANNOUNCEMENT

HM65R

1400 LUMENS

SKU: HM65RL2BK
EAN: 6942870306629

BATTERIES INCLUDED | LOW VOLTAGE WARNING | RECHARGEABLE

The Fenix HM65R headlamp features both an independently controlled spotlight and a floodlight for a combined maximum 1400 lumens of neutral white light. Powered by the included 3500mAh battery, this headlamp is USB-C rechargeable and includes a battery level indicator. It is made of a magnesium alloy for better strength, impact resistant to 2 meters (6.6ft), and less weight. Perfect for work or outdoor adventures, and those needing the brightest hands-free lighting and long runtimes in a small, light-weight package.

- **Max 1400 lumen output from an included 18650 rechargeable Li-ion battery or two CR123A batteries**
- **Seven modes including four spotlight levels and three floodlight levels**
- **USB-C rechargeable with battery level indicator**
- **Built with a magnesium alloy for lighter weight**
- **Limited Lifetime Guarantee from Fenix Lighting USA**

ANSI/FSC	Spotlight Mode				Floodlight Mode		
	Low	Med	High	Turbo	Low	Med	High
OUTPUT LUMENS	50	130	400	1000	8	130	400
RUNTIME	97h	48h	22h	2h	300h	50h	21h
DISTANCE	121ft (37m)	187ft (57m)	331ft (101m)	535ft (163m)	20ft (6m)	98ft (30m)	180ft (55m)
INTENSITY	350cd	833cd	2600cd	6677cd	9cd	220cd	762cd
IMPACT RESISTANCE	2m						
WATERPROOF/ DUSTPROOF	IP68, dustproof/waterproof underwater to 2m						
SIZE	Length: 3.2" (80.5mm) Width: 2.2" (55mm) Height: 1.6" (40mm)						
WEIGHT	3.4 oz. (97g) excluding battery						
INCLUDED	ARB-L18-3500 rechargeable li-ion battery, headband, top headband, headband mount, spare O-ring, charging cable						

*The runtime of turbo is the cumulative time when overheat protection active.

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All pricing and specifications subject to change without notice.

Attachment E.1, Fenix HM65R Headlamp Product Data (Page 3 of 7)

ANSI/PLATO FL1	SPOTLIGHT MODE				FLOODLIGHT MODE		
	TURBO	HIGH	MED	LOW	HIGH	MED	LOW
Output	1000 lumens	400 lumens	130 lumens	50 lumens	400 lumens	130 lumens	8 lumens
Runtime	4 hours	22 hours	42 hours	90 hours	20 hours	48 hours	280 hours
Distance	163 meters	101 meters	57 meters	37 meters	55 meters	30 meters	6 meters
Intensity	6677 candelas	2600 candelas	833 candelas	350 candelas	762 candelas	220 candelas	9 candelas
Impact Resistance	2 meters						
Waterproof	IP68 , underwater 2 meters						

Note: The above specifications are the test results given by Fenix through its laboratory testing using Fenix ARB-L18-3400 battery under the temperature of 21±3°C and humidity of 50% - 80%. The true performance of this product may vary according to different working environments and the actual batteries used.

*The Turbo output is measured in total of runtime including output at reduces levels due to temperature or protection mechanism in the design.

Attachment E.1, Fenix HM65R Headlamp Product Data (Page 4 of 7)

FENIX SEE WHAT MATTERS™ www.fenixlighting.com

NEW PRODUCT ANNOUNCEMENT

ALG-03
HEADLAMP HELMET MOUNT

Model: ALG-03
EAN: 6942870304717

- Quickly attach and detach the HL55 or HL60R headlamp to any outdoor or work helmet
- Allows for adjustment of the lighting angle
- Attach the mount easily with included 3M adhesive tape (white) or TESA adhesive tape (blue)
- Durable nylon construction
- Limited Lifetime Guarantee from Fenix Lighting U.S.

Size	Length: 6.14" (156mm) Width: 4.53" (115mm) Height: 0.79" (20mm)
Weight	2.12 oz. (60g)
Included	One 3M adhesive tape (white), one TESA adhesive tape (blue)

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Attachment E.1, Fenix HM65R Headlamp Product Data (Page 5 of 7)

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NEW PRODUCT ANNOUNCEMENT

ARB-L18-3500

SKU: ARB-L18-3500
EAN: 6942870303505

ARB-L18-3500 is a high capacity 18650 Li-ion rechargeable with a protection circuit in the anode to help prevent short circuits, over charge/discharge and over heating. The battery also includes pressure relief vents which expel waste gas in the rare case of an internal short circuit preventing an explosion.

- **3500mAh high capacity**
- **Protection circuitry to prevent short circuits**
- **Pressure vents to prevent explosions**
- **500 charge cycles**

Model	ARB-L18-3500
Capacity	3500mAh
Voltage	3.6V
Charging Current	Recommended 1A, maximum 2A
Weight	1.8 ounces (50g)
Size	Length: 2.7" (69mm) Diameter: 0.7" (18.6mm)
Warranty Period	12 month from date of purchase

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Attachment E.1, Fenix HM65R Headlamp Product Data (Page 6 of 7)

FENIX SEE WHAT MATTERS™ www.fenixlighting.com

NEW PRODUCT ANNOUNCEMENT

ARB-L18-3400

Model: ARB-L18-3400
EAN: 6942870303888

ARB-L18-3400 is a high capacity 18650 Li-ion rechargeable with a protection circuit in the anode to help prevent short circuits, over charge/discharge and over heating. The battery also includes pressure relief vents which expel waste gas in the rare case of an internal short circuit preventing an explosion.

- **3400mAh high capacity**
- **Protection circuitry to prevent short circuits**
- **Pressure vents to prevent explosions**
- **500 charge cycles**

Model	ARB-L18-3400
Capacity	3400mAh
Voltage	3.6V
Charging Current	Recommended 1A, maximum 2A
Weight	1.8 ounces (50g)
Size	Length: 2.7" (69mm) Diameter: 0.7" (18.6mm)
Warranty Period	12 month from date of purchase

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Attachment E.1, Fenix HM65R Headlamp Product Data (Page 7 of 7)

CUSTOMER SERVICE

15 Days Free Replacement

15 days free replacement: Fenix will replace a new product within 15 days of purchase for any manufacturing defects if problems come into being in normal use; We will replace it with the same model. If the model has been discontinued, customers will receive a product with similar or improved model.

5 Years Free Repair

5 years free repair: Fenix will offer free repair within 5 years for lights from the date of purchase if problem develops with normal use. Different warranty period for different products:

Product Type	Warranty
Flashlights,tactical lights, headlamps, bicycle lights, camping lanterns (included rechargeable lights but not built-in battery)	5 years (battery for 1 year)
Flashlights,tactical lights, headlamps, bicycle lights, camping lanterns(with built-in battery)	2 years (battery included)
Rechargeable batteries, chargers, bike mount, and remote pressure switch	1 year

Limited Lifetime Warranty

Limited lifetime warranty: For lights past the free repair warranty period, we provide lifetime repairs but will charge for parts. The distributor will notify customer the cost of the part before repair.

Extended warranty service

Extra 6-month warranty period is obtained once you have successfully registered on the official website for Fenixlight Limited (www.fenixlight.com), which only applies to flashlights, tactical lights, headlamps, bike lights and camping lanterns.

Warranty Certificate

Customers requesting after-sales service from Fenix distributors or dealers, should present their completed Fenix Warranty Card, purchase invoice or receipt. The distributor should then provide service to the customer/s, and Fenix will support backup for this service.

The free warranty does not cover any damages or failure caused by:

(1) Normal wear
(2) Rough operation
(3) Battery leakage
(4) Any defects or damages caused by the improper operations include but not limited to the operation which doesn't comply with the warranty or notes shown in the product specification. For example, the product specification will describe that please don't disassemble the sealed head, as doing so can damage to the flashlight and will void the warranty'
(5) Any defects or damaged led by other behaviors which can not be controlled by Fenix reasonably.

For any problems/suggestions, please email our Customer Service Department:

service@fenixlight.com (Europe/America regions)
service_1@fenixlight.com (Asia/Oceania/Africa regions)
Tel: +86 400 8866 093 / +86 755 2963 1193

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Attachment E.2, Light Meter Information (Page 1 of 3)

SD card real time datalogger
+ Type K/J thermometer

LIGHT METER

Model : LX-1128SD

Attachment E.2, Light Meter Information (Page 2 of 3)

Light meter

Measuremer	Range	Max. In-range Display
LUX *@ auto range*	2,000 LUX	0 - 1,999 LUX
	20,000 LUX	1,800 - 19,990 LUX
	100,000 LUX	18,000 - 99,900 LUX
Feet-candle *@ auto range*	200 Ft-cd	0 - 186.0 Ft-cd
	2,000 Ft-cd	167.0 - 1,860.0 Ft-cd
	10,000 Ft-cd	1,670.0 - 9,290.7 Ft-cd

Range	Resolution	Accuracy
2,000 LUX	1 LUX	± (4 %+2 dgt)
20,000 LUX	10 LUX	
100,000 LUX	100 LUX	
200 Ft-cd	0.1 Ft-cd	
2,000 Ft-cd	1 Ft-cd	± (4 % +2 Ft-cd)
10,000 Ft-cd	10 Ft-cd	± (4 %+20 Ft-cd)
Note : Accuracy tested by a standard parallel light tungsten lamp of 2856 K degree temperature.		

Attachment E.2, Light Meter Information (Page 3 of 3)

P.A.S. Distribution, Inc.

CALIBRATION CERTIFICATE

NO. 0600318

CUSTOMER: EVERGY- WOLF CREEK
BURLINGTON, KS 66839

EQUIPMENT: LUTRON
DESCRIPTION: Light Meter
LX-1128SD
SERIAL NO.: T016275

CALIBRATION DATE: 03/17/2021

TEST CONDITION:
70°F, 48% RH

RECEIVED CONDITION: NEW

WORK PERFORMED: Validated Calibration to Manufacturer's Specifications.

STANDARDS USED: Wavelength of source: Standard light tungsten lamp of 2856 Deg. K Temperature.

Standard Calibrated Source S/N 1694C-102	Calibration Data Model No. LX-1128SD S/N T016275	Accuracy
000	000	
100	98	
200	196	
500	488	± (5% + 2 dgt)
1000	973	

TECHNICIAN: _____ REVIEWED/APPROVED: _____

We hereby certify that the measuring devices used have been calibrated in accordance with our standard working procedure, using measuring equipment and calibration standards, which are NIST Traceable. There is no way to determine how long calibration will be maintained. This instrument could be affected by aging, temperature, shock and contamination.

Attachment E.3, Peer Plant Portable Light Information (Page 1 of 1)

NOT APPROVED FOR USE AS PRIMARY EMERGENCY LIGHTING TO ILLUMINATE OPERATOR MANUAL ACTIONS AT WOLF CREEK

UK Underwater Kinetics
13400 Danielson St. Poway, CA 92064 USA
US Toll Free (800) 852-7483 / +1 (858) 513-9100
Info@uwk.com / www.uwk.com

4AA XENON

The 4AA Xenon Front Switch matches high performance with a sleek, compact design that can be operated with gloves. A xenon bulb provides vibrant color clarity. It is the most reliable, cost-effective flashlight you'll ever own.

FEATURES

- 2.1 watt high brightness xenon filled lamp
- Rubber sheath molded over bezel to reduce glare and improve impact resistance (passes UL 30 ft drop to concrete test)
- Push-button thumb switch
- Prefocused high intensity spot beam
- New easy loading drop-in battery compartment for quick reload of batteries
- Hydrogen scrubber catalyst, polarized battery contacts and 0-psi vent minimize explosive risk from leaking batteries
- Tough, non-corroding ABS and polycarbonate plastic construction

Mounts to any hard hat with UK helmet clips

Available in front and tail switch configurations

SPECIFICATIONS

c UL us LISTED — CL I, DIV 2, GP A, B, C, D, CL II, DIV 2 GP G, CL III, DIV 2 T2A

Brightness	38 Lumens
Burn Time	4-5 hrs
Beam Distance	311 ft / 95 m
Lamp	Xenon
Batteries	4 AA Alkaline / LR6
Size	6.1 x 1.6 x 1.4 in / 15.5 x 4.1 x 3.6 cm
Weight	5.5 oz / 155.9 g

MADE IN USA

PART NUMBERS / ACCESSORIES

514108	UK4AA-AS2 Xenon (CL I Div 2), Front Switch, Black
514109	UK4AA-AS2 Xenon (CL I Div 2), Front Switch, Orange
514120	UK4AA-AS2 Xenon (CL I Div 2), Front Switch, Safety Yellow

514816
Nylon Belt Pouch, 4AA/3AA

514877
Traffic Director Wand
2AA/4AA/Nitex Pro

REV: 9/19

Attachment E.4, Photos from Lighting Performance Test

General Area Lighting

Photo E.4.A-1, Normal Lighting On

Photo E.4.A-2, No Lighting

Attachment E.4, Photos from Lighting Performance Test

Teledyne Big Beam Emergency Light

E.4.B-1, Teledyne Big Beam Emergency Light

E.4.B-2, Target at 10 ft. and Battery Charged

E.4.B-3, Target at 10 ft. and Battery Discharged 8-Hours

Attachment E.4, Photos from Lighting Performance Test

Fenix HM65R Headlamp Mounting

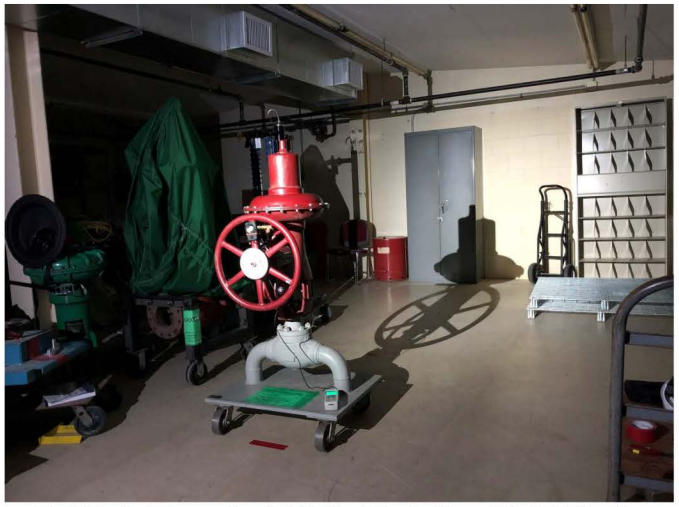
E.4.C-1, Front View

E.4.C-2, Closeup Front View

E.4.C-3, Side View

Attachment E.4, Photos from Lighting Performance Test

Fenix HM65R Headlamp with Rechargeable Battery



E.4.D-1, Target at 10 ft. High Spotlight Mode

E.4.D-2, Target at 10 ft. High Floodlight Mode

E.4.D-3, Target at 10 ft. High Spotlight Mode & Battery Discharged 1.5-Hours on High Spotlight

E.4.D-4, Target at 10 ft. High Floodlight Mode & Battery Discharged 1.5-Hours on High Spotlight

Attachment E.4, Photos from Lighting Performance Test

Fenix HM65R Headlamp with Rechargeable Battery (Cont'd)

E.4.D-5, Target at 10 ft. High Spotlight Mode & Battery Discharged 8-Hours on High Spotlight

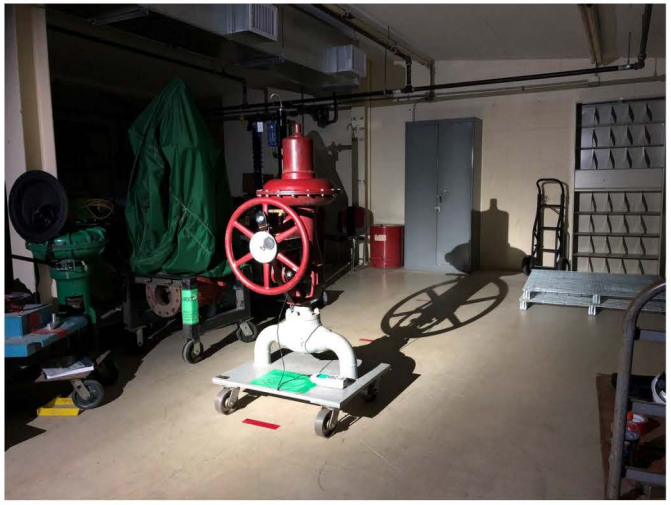
E.4.D-6, Target at 10 ft. High Spotlight Mode & Battery Discharged 16-Hours on High Spotlight

Attachment E.4, Photos from Lighting Performance Test

Fenix HM65R Headlamp with CR123 Batteries

E.4.E-1, Target at 10 ft. High Spotlight Mode

E.4.E-2, Target at 10 ft. High Floodlight Mode



E.4.E-3, Target at 10 ft. High Spotlight Mode & Batteries Discharged 1.5-Hours on High Spotlight

E.4.E-4, Target at 10 ft. High Floodlight Mode & Batteries Discharged 1.5-Hours on High Spotlight

Attachment E.4, Photos from Lighting Performance Test

Fenix HM65R Headlamp with CR123 Batteries (Cont'd)

E.4.E-5, Target at 10 ft. Low Floodlight Mode & Batteries Discharged 8-Hours on High Spotlight

Attachment E.4, Photos from Lighting Performance Test

Underwater Kinetics UK4AA-AS2 Flashlight

E.4.F-1, Target at 10 ft.

E.4.F-2, Target at 10 ft. & Batteries Discharged 1.5-Hours