M880512C
177

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555

May 20, 1988

MEMORANDUM FOR: Victor Stello, Jr.
Executive Director for Operations

FROM: Samuel J. Chilk, Secretary

SUBJECT: TAFF REQUIREMENTS - AFFIRMATION/DISCUSSION AND VOTE, 3:30 P.M., THURSDAY, MAY 12, 1988, COMMISSIONERS' CONFERENCE ROOM, ONE WHITE FLINT NORTH, ROCKVILLE, MARYLAND (OPEN TO PUBLIC ATTENDANCE)

1. SECY-88-94 - Final Rule Amendments to 10 CFR Parts 30, 40, 50, 51, 70, and 72: General Reguirements for Decommissioning Nuclear Facilities (SECY-87-309)

The Commission, by a 5-0 vote,* approved final amendments to its regulations to set forth technical and financial criteria for decommissioning licensed nuclear facilities. The amendments are intended to assure that decommissioning of all licensed facilities will be accomplished in a safe and timely manner and that adequate licensee funds will be available for this purpose.

The Federal Register Notice should be forwarded for signature and publication.
(EDO) (SECY Suspense: 6/13/88)

* Section 201 of the Energy Reorganization Act, 42 U.S.C. •5841, provides that action of the Commission shall be determined by a "majority vote of the members present." Commissioner Carr was not present when this item was affirmed. Accordingly the formal vote of the Commission was 4-0 in favor of the decision. Commissioner Carr, however, had previously indicated that he would approve this paper and had he been present he would have affirmed his prior vote.

II. SECY-88-22 Final Station Blackout Rule', USI A-44

The Commission, by a 5-0 vote,* approved a final rule on station blackout (as attached). The objective of this rule is to reduce the risk of severe accidents associated with station blackout. The rule requires light water cooled nuclear power plants to maintain reactor core cooling during a specified period of loss of offsite and onsite emergency AC power systems.

In addition. The first page of the Regulatory Guide 1.155 should be revised as shown on the enclosed copy.

The Federal Register Notice should be forwarded for signature and publication.
(EDO) (SECY Suspense: 6/13/88)

Attachment:
As stated

cc: Chairman Zech
Commissioner Roberts
Commissioner Bernthal
Commissioner Carr
Commissioner Rogers
OGC
GPA
PDR - Advance
DCS - P1-124

* Section 201 of the Energy Reorganization Act, 42 U.S.C. •5841, provides that action of the Commission shall be determined by a "majority vote of the members present." Commissioner Carr was not present when this item was affirmed. Accordingly the formal vote of the Commission was 4-0 in favor of the decision. Commissioner Carr, however, had previously indicated that he would approve this paper and had he been present he would have affirmed his prior vote.

[7590-01]
179

ENCLOSURE B

Federal Register Notice of Final Rulemaking

NUCLEAR REGULATORY COMMISSION
10 CFR Part 50
Station Blackout

AGENCY: Nuclear Regulatory Commission.

ACTION: Final rule.

SUMMARY: The nuclear Regulatory Cummission is amending its regulation s to require that light-water-cooled nuclear power plants be capable of wit hstanding a total loss of alternating current (ac) electric power (called "stati on black-out") for a specified duration and maintaining reactor core cooling du ring that period. This requirement is based on information developed under the Commission's study of Unresolved Safety Issue A-44, "Station Blackout. " The amendment is intended to provide further assurance that a loss of both offsite power and onsite emergency ac power systems will not adversely affect the public health and safety.

EFFECTIVE DATE:

FOR FURTHER INFORMATION CONTACT: Aleck Serkiz, Division of Reactor an d Plant Systems, Office of Nuclear -Regulatory Research, U.S. Nuclear Regulato ry Commission, Washington, DC 20555, Telephone: (301) 492-3555.

180

-2-
[7590-01]

SUPPLEMENTARY INFORMATION:

Background

The alternating current (ac) electric Power for essential and nonessen tial service in a nuclear power plant is Supplied primarily by Offsite powe r. Redundant onsite emergency ac Power systems are also provided in the e vent that all offsite Power sources are lost. These systems provide Power for v arious safety functions, including reactor core decay heat removal and contai nment

heat removal, which are essential for preserving the integrity of the reactor
core and the containment building, respectively. The reactor core decay heat
can also be removed for a limited time period by safety systems that are
independent of ac power.

The term "station blackout" means the loss of offsite ac power to the essential
and nonessential electrical buses concurrent with turbine trip and the
unavailability of the redundant onsite emergency ac power systems (e.g., as a
result of units out of service for maintenance or repair, failure to start on
demand, or failure to continue to run after start). If a station blackout
persists for a time beyond the capability of the ac-independent systems to
remove decay heat, core melt and containment failure could result.

The Commission's existing regulations establish requirements for the design and
testing of onsite and offsite electric power systems that are intended to
reduce the probability of losing all ac power to an acceptable level. (See
General Design Criteria 17 and 18, 10 CFR Part 50, Appendix A.) The existing
regulations do not require explicitly that nuclear power plants be designed to
assure that core cooling can be maintained for any specified period of loss of
all ac power.

As operating experience has accumulated, the concern has arisen that the
reliability of both the onsite and offsite emergency ac power systems might be
less than originally anticipated, even for designs that meet the requirements
of General Design Criteria 17 and 18. Many operating plants have experienced a
total loss of offsite power, and more occurrences can be expected in the

[7590-01]

future. Also, operating experience with onsite emergency Power systems has included many instances when diesel generators failed to start. In a few cases, there has been a complete loss of both the offsite and the onsite ac power systems. During these events, ac power was restored in a short time without any serious consequences.

In 1975, the results of the Reactor Safety Study (WASH-1400)1 showed that station blackout could be an important contributor to the total risk from nuclear power plant accidents. Although this total risk was found to be small and not undue, the relative importance of the station blackout accident was established. Subsequently, the Commission designated the issue of station blackout as an Unresolved Safety Issue (USI); a Task Action Plan (TAP A-44) was issued in July 1980, and studies were initiated to determine whether additional safety requirements were needed. Factors considered in the analysis of risk from station blackout included: (1) the likelihood and duration of the loss of offsite power; (2) the reliability of the onsite ac power system; and (3) the potential for severe accident sequences after a loss of all ac power, including consideration of the capability to remove core decay heat without ac power for a limited time period.

The technical findings of the staff's studies of the station blackout issue are presented in NUREG-1032, "Evaluation of Station Blackout Accidents at Nuclear Power Plants, Technical Findings Related to Unresolved Safety Issue A-44." Additional information is provided in supporting contractor reports: NUREG/CR-3226, "Station Blackout Accident Analyses," published in May 1983; NUREG/CR-2989, "Reliability of Emergency AC Power Systems at Nuclear Power Plants," published in July 1983; NUREG/CR-3992, "Collection and Evaluation of

Copies of all NRC documents are available for public inspection and co
pying
for a fee at the NRC Public Document Room at 1717 H Street, NW, Washin
gton,
DC 20555. Copies of published documents may also be purchased through
the
U.S. Government Printing Office by calling (202) 275-2060 or by writin
g to
the Superintendent of Documents, U.S. Government Printing Office, P. 0
. Box
37082, Washington, DC 20013-7082.

182

-4-
[7590-01]

Complete and Partial Losses Of Offsite Power at Nuclear Power Plants,"
published in February 1985; and NUREG/CR-4347, "Emergency Diesel Gener
ator
Operating Experience, 1981-1983," published in December 1985. The maj
or
results of these studies are given below.

øLosses of offsite power can be characterized as those resulting from
plant-centered faults, utility grid blackout, and severe-weather-induc
ed
failures of offsite power sources. Based on operating experience, the
frequency of total losses of offsite power in operating nuclear power
plants was found to be about one per 10 site-years. The median
restoration time was about one-half hour, and 90 percent of the offsit
e
power losses were restored within approximately 3 hours (NUREG/CR-3992
).

øThe review of a number of representative designs of onsite emergency
ac
power- systems has indicated a variety of potentially important failur
e
causes. However, no single improvement was identified that could resu
lt
in a significant improvement in overall diesel generator reliability.

Data obtained from operating experience in the period from 1976 to 198
0
showed that the typical individual emergency diesel generator failure
rate was about 2.5 x 10-2 per demand (i.e., one chance of failure in

40
demands), and that the emergency ac power system unavailability for a plant which has two emergency diesel generators, one of which was required for decay heat removal, was about 2 x 10-3 per demand (NUREG/CR-2989).

øCompared to the data in NUREG/CR-2989, updated estimates of emergency diesel generator failure rates indicated that diesel generator reliability has improved somewhat from 1976 to 1983. For the period 1981 to 1983, the mean failure rate for all demands was about 2.0 x 10-2 per demand (i.e., one chance of failure in 50 demands). However, the data also indicate that 'the probability of diesel generator failures during actual demands (i.e., during losses of offsite power) is greater than that during surveillance tests (NUREG/CR-4347).

183

-5-
[7590-01]

øGiven the occurrence of a station blackout the likelihood of resultant core damage or core melt is dependent on the reliability and capability of decay heat removal systems that are not dependent on ac power. If sufficient ac-independent capability exists, additional time will be available to restore ac power needed for long-term cooling (NUREG/CR-3226).

øIt was determined by reviewing design, operational, and site-dependent factors that the expected frequency of core damage resulting from station blackout events could be maintained near 10-5 per reactor-year with readily achievable diesel generator reliabilities, provided that plants are designed to cope with station blackout for a specified duration. The duration for a specific plant is based on a comparison of the plant's characteristics to those factors that have been identified as the main contribuLurs to risk from station blackout (NUREG-1032).

The staff's technical findings show that station blackout does not pose an undue risk to public health and safety. The findings summarized above show

that recovery from loss of offsite power occurs for the most part in l
ess than
4 hours, emergency diesel generator reliability is high (i.e., ? 0.95)
, and
that given a station blackout the likelihood of core damace is more de
pendent
on decay heat removal systems that are non-ac-dependent. However, pla
nt design
and operational characteristics, plus site-dependent factors (such as
anticipated weather conditions) introduce a level of variability which
warrants
a need for plant-specific coping analyses to provide greater assurance
that
core cooling can be maintained until ac power is restored. Thus the C
ommission
believes that •50.63 of 10 CFR Part 50 will bring about a significant
increase
in protection to the public health and safety. As a result of station
blackout
coping analyses, improved guidance will be provided to licensees regar
ding
maintaining minimum emergency diesel generator reliability to minimize
the
probability of losing all ac power. In addition, the Commission is am
ending
its regulations by adding a new •50.63 to require that all nuclear pow
er plants
be capable of coping with a station blackout for some specified period
of time.
The period of time for a specific plant will be determined based on a
comparison

184

-6-
[7590-01]

of the individual plant's design with factors that have been identifie
d as the
main contributors to risk of core damage resulting from station blacko
ut.

These factors, which vary significantly from plant to plant because of
considerable differences in design of plant electric power systems as
well as
site-specific considerations, include: (1) redundancy of onsite emerge
ncy ac
power sources (i.e., number of sources minus the number needed for dec
ay heat

removal), (2) reliability of onsite emergency ac power sources (usuall y diesel generators), (3) frequency of loss of offsite power, and (4) probable time to restore offsite power. The frequency of loss of, and time to restore, offsite power are related to grid and switchyard reliabilities, historical wea ther data for severe storms, and the availability of nearby alternate power sour ces (e.g., gas turbines). Experience has shown that long duration offsite power outages are caused primarily by severe storms (hurricanes, ice, snow, etc.).

The objective of the rule is to reduce the risk of severe accidents re sulting from station blackout by maintaining highly reliable ac electric power systems and, as additional defense-in-depth, assuring that plants can cope wit h a station blackout for some period of time. The rule requires all plant s to be able to cope with a station blackout for a specified acceptable durati on selected on a plant-specific basis. All licensees and applicants are required to assess the capability of their plants to cope with a station blacko ut (i.e., determine that the plant can maintain core cooling with ac power unava ilable for an acceptable period of time), and to have procedures and training to cope with such an event. Licensees may use an alternate ac power source if that source meets specific criteria for independence and capacity and can b e shown to be available within one hour to cope with a station blackout. A co ping analysis is not required for those plants that choose this alternate a c approach if the alternate ac can be demonstrated by test to be availab le to power the shutdown buses within 10 minutes of the onset of station bla ckout. Use of an alternative ac source, one that minimizes common mode failur e, is a preferred option since this approach will also benefit other safety co ncerns.

On the basis of station blackout studies conducted for US! A-44 and pr

esented
in the reports referenced above, the NRC staff has developed Regulator
y Guide

185

-7-
[7590-01]

1.155 entitled "Station Blackout," which presents guidance on (1) mai
ntaining
a high level of reliability for emergency diesel generators, (2) devel
oping
procedures and training to restore offsite and onsite emergency ac pow
er should
either one or both become unavailable, and (3) selecting a plant-speci
fic
acceptable station blackout duration which the plant would be capable
of sur-
viving without core damage. Application of the methods in this guide
would
result in selection of an acceptable station blackout duration (e.g.,
2, 4, 8,
or 16 hours) which depended on the specific plant design and site-rela
ted
characteristics acceptable to the staff. However, applicants and lice
nsees
could propose alternative methods to those specified in the regulatory
guide in
order to justify other acceptable durations for station blackout capab
ility.
Additionally, the regulatory guide on station blackout presents guidan
ce on
quality assurance and specifications for alternate ac source(s) and no
n-safety-
related equipment required for coping with station blackout. The equi
pment
installed to meet the station blackout rule must be implemented so tha
t it
does not degrade the existing safety-related systems. This is to be
accomplished by making the non-safety-related equipment independent to
the
extent practicable from existing safety-related systems. The guidance
provided
in the regulatory guide illustrates the specifications that the staff
would find acceptable for non-safety systems and equipment. The quali
ty
assurance guidance for the non-safety-related equipment for which ther
e are no

existing NRC quality assurance requirements (e.g., Appendix B, Appendi
x R)
embody the following elements: (1) design control and procurement docu
ment
control, (2) instructions, procedures and drawings, (3) control of pur
chased
material, equipment and services, (4) inspection, (5) test and test co
ntrol,
(6) inspection, test and operating status, (7) non-conforming items, (
8)
corrective action, (9) records, (10) audits. NRC inspections will foc
us on the
implementation and the effectiveness of these quality controls as desc
ribed in
the regulatory guide.

Based on the rule and regulatory guide, those plants with an already l
ow risk
from station blackout would be required to withstand a station blackou
t for a
relatively short period of time and probably would need few, if any, m
odifi-
cations as a result of the rule. Plants with currently higher risk fr
om

186

-8-
[7590-01]

station blackout would be required to withstand somewhat longer durati
on
blackouts. Depending on their existing capability, these Plants might
need to
make hardware modifications (such as increasing station battery capaci
ty or
condensate storage tank capacity) in order to cope with the longer sta
tion
blackout duration. The rule requires that each light-water-cooled nuc
lear
power plant licensed to operate must be able to withstand for a specif
ied
duration and recover from a station blackout. The rule requires each
plant to
perform a coping analysis and identify the coping duration, along with
the
basis therefor and a description of procedures established for coping
and
recovery. If modifications to equipment or plant procedures are neces

sary,
these are to be identified and a schedule provided for implementing su ch
changes.

It should be noted, based on all evidence that staff has on hand, that no undue
risk exists with, or without, the promulgation of the station blackout rule.
However, station blackout may still remain an important contributor to residual
risk. This station blackout rule will enhance safety by accident prev ention
and thereby reduce the likelihood of a core damage accident being caus ed by a
station blackout occurrence. This does not mean however , that furthe r
enhancements in reducing the overall residual risk are not achievable by
additional improvements in severe accident management, given the assum ption
that core damage occurs, whether from station blackout sequences or ot her
causes (such as small or large loss-of-coolant accident sequences).
Initiatives that provide such safety enhancements (through improvement s of core
damage management procedures) are currently being pursued apart from t he
station blackout rule. Therefore, this rule should be viewed as being in the
same accident prevention context as the ATWS rule (•50.62) and the fir e
protection rule (•50.48) in that it recognizes, as the other two rules
recognize, multiple failure possibilities resulting from common cause effects
that should be addressed. This concern has been recognized in the Int roduction
to Appendix A of 10 CFR Part 50.

187

-9-
[7590-01]

Proposed Rule

On March 21, 1986. the Commission published a proposed rule in the
Federal Register (51 FR 9829) that would require (1) light-water-coole d nuclear

power plants to be capable of coping with a station blackout for a specified duration, and (2) licensees to determine the maximum duration for which their plants as currently designed are able to cope with a station blackout. A 90-day comment period expired on June 19, 1986.

On April 3, 1986 (13 days after the proposed rule was published), the NRC published in the Federal Register (51 FR 11494) a notice of availability and request for comments on a draft regulatory guide entitled "Station Blackout" (Task SI 501-4). This draft guide provided guidance for licensees to comply with the proposed station blackout rule. Many letters commenting on the proposed rule also included comments on the draft regulatory guide. Responses to these comments provided below address the public comments on the draft guide as well as on the proposed rule.

Comments on the Proposed Rule

The Commission received 53 letters commenting on the proposed rule.,- Forty-five of these were from the nuclear industry, comprised of electric utilities, consortiums of electric utilities, vendors, a trade association, and an architect/engineering fi m. Other letters were submitted by the Union of Concerned Scientists, the Department of Nuclear Safety of the State of Illinois, a representative of the Professional Reactor Operator Society, a citizens group, a consultant, and three individuals. Largely, the industry comments were opposed to generic rulemaking to resolve the station blackout issue. The Nuclear Management and Resources Council (NUMARC), formerly the Nuclear Utilities Management and Resources Committee, submitted, along with its

ýCopies are available for public inspection and copying for a fee at the NRC Public Document Room at 1717 H Street, NW, Washington, DC.

comments on the proposed rule, a set of four industry initiatives that it believes would resolve this issue without rulemaking. Thirty-nine of the industry letters supported NUMARC's submittal. NUMARC proposed a fifth initiative (see item 21) by letter dated October 5, 1987. On the other hand, the Union of Concerned Scientists, the Illinois Department of Nuclear Safety, and the citizens group supported the Commission's objective in the proposed rule, but did not believe the rule and guidance associated with the rule went far enough to reduce the possibility of a serious accident that could be initiated by a total loss of ac power.

Every letter was reviewed and considered by the staff in formulating the final resolution of USI A-44. Because of the large number of comments, it was not practical to prepare formal responses to each one separately. However, since many comments were on similar subjects, the discussion and response to the comments have been grouped into the following subjects: 3

1. Quality classification of modifications

2. Whether the backfit analysis adequately implements the Backfit Rule

3. Cost-benefit and whether •50.63 meets "substantial increase the overall protection of the public health and safety"

4. Whether NRC should require substantial improvements in safety that go beyond those proposed in this rulemaking

5. The need for generic rulemaking

6. Applicability of the proposed •50.63 to specific plants

7. Plant-specific features and capabilities

The first four subjects are ones on which the Commissioners specifically requested public comments when the proposed rule was published.

189

-11-
[7590-01]

8. The source term used to estimate consequences

9. Specificity on the extent of required coping studies

10. Acceptable duration for coping with a station blackout

11. Credit for alternate or diverse ac power sources

12. Trends on the reliability of ac power sources

13. Sharing of emergency diesel generators between units at multi-unit sites

14. Clarification of the definitions of station blackout and diesel generator failure

15. Specificity and clarification of requirements

16. Technical comments on NUREG-1032

17. Relationship of USI A-44 to other NRC Generic Issues

18. An alternative of plant-specific probabilistic assessments

19. Procedures and operator actions during station blackout

20. Schedule provisions in the proposed •50.63.

21. Industry initiatives

The comments and responses to each of these subjects are presented on the following pages.

190

-12-
[7590-01]

1. Quality Classification of Modifications

The Commission requested comments on whether the staff should give further consideration to upgrading to safety grade the plant modifications needed (if any) to meet the proposed rule. Upgrading to safety grade would further ensure appropriate licensee attention is paid to maintaining equipment in a high state of operability and reliability.

Comments - The prevailing view by industry on this subject is represented by the following comments submitted by NUMIARC:

Quality classification is unnecessary - Equipment used to prevent or respond to a station blackout should be sufficiently available and operable to meet its required function. To this extent, the Commission's desire that appropriate attention be paid to maintaining a sufficiently high state of operability and reliability is appropriate. The point of departure begins with the method for achieving this objective. Specifically, by itself, a "safety grade" classification scheme does not solely equate with high states of equipment operability and reliability. Such classification systems too often can become a documentation exercise more than a process for providing the requisite level of system functionality.

Duquesne Light agreed with this view and expressed the following comments:

Any plant modifications or additional equipment required to meet the proposed rule should not be specified safety grade. For equipment which is to be manually started and placed in service for testing or in the event of a loss of power condition there is no necessity for specifying safety grade since adequate reliability can be obtained through normal surveillance testing and the proper maintenance of commercial power plant equipment. The cost difference in safety grade vs. commercial grade modifications is significant and must be emphasized.

The opposite point of view was taken by the Illinois Department of Nuclear Safety.

No credit should be given for the capability of equipment to respond t
o a
station blackout unless that equipment was originally designed,
constructed, inspected, performance tested, qualified, certified for t
he
intended safety-related purpose, and the equipment is maintained to th
e
highest industry safety standards.

191

-13-
[7590-01]

Gulf States Utilities commented,

The proposed rule does not provide sufficient direction on the quality
classification of plant modifications that may be required to meet the
 rule.
...the quality classification of plant modifications implemented to me
et the
proposed rule should be commensurate with classification of the system
 they
support.

Response - The proposed •50.63 does not specifically address the topic
 of
safety classification of plant modifications; however, detailed guidan
ce is
provided in Regulatory Guide 1.155 dealing with quality assurance and
equipment
specifications for non-safety-related equipment. Any safety-related e
quipment
used either presently, or in modifications resulting from this rule, s
hould
meet the criteria currently applied to such equipment.

The technical analyses performed for USI A-44 (NUREG-1032) show that
plant-centered events (i.e., those events in which design and operatio
nal
characteristics of the plant itself play a role in the likelihood of l
oss of
offsite power), and area- or weather-related events (e.g., grid reliab
ility or
external influences on the grid) are the dominant causes of loss of of
fsite
power. Neither seismic events nor events related to single failure ca
uses
were found to be major contributors to loss of offsite power. Therefo

re, both
the staff's findings and public comments received do not support an ex plicit
need for plant modifications for coping with station blackout to be se ismically
qualified.

The substantial increase in protection sought by this rule can be achi eved by
modifications which meet criteria somewhat less stringent than general ly
required by safety grade criteria. Safety-related equipment modificat ions to
meet all safety-grade-related criteria would be more burdensome and ex pensive
and would likely achieve only a very small further reduction in risk. The
major contributors to the residual risk of loss of offsite power are a dequately
dealt with by modifications which conform to the quality assurance and equipment specification guidance provided in Regulatory Guide 1.155.

192

-14-
[7590-01]

2. Whether the Backfit Analysis Adequately Implements the Backfit Rul e

In addition to comments on the merits of the proposed rule, the Commis sion
specifically requested comments on whether the backfit analysis for th is rule
adequately implements the Backfit Rule, •50.109 of 10 CFR Part 50.

Comments - The Commission received two differing views in response to this
request. On one hand, NUMARC expressed the view that the proposed rul e does
not meet the backfit rule standard because the analysis of the factors set

forth in •50.109(c) were not adequately considered by the staff. Spec ifically,
NUMARC stated:

1. Installation and continuing costs associated with the
backfit have been underestimated.

2. Potential impacts on radiological exposure of facility employees should be further addressed.

3. The relationship to proposed and existing regulatory requirements should be considered further.

4. Potential impacts of differences in facility, type, design, or age should be considered further.

5. The reduction in risk from offsite releases to the public has been overestimated.

On the other hand, the Ohio Citizens for Responsible Energy (OCRE) and the Union of Concerned Scientists commented that the backfit rule should not apply to the proposed rule. OCRE took the position that "application of the backfit rule to [NRC] rulemakings ... is plainly illegal," and the Commission is not empowered to consider costs to licensees in deciding whether to impose new requirements. The Union of Concerned Scientists commented that the cost-benefit analysis should not be applied in this case because safety improvements

193

-15-
[7590-01]

are needed to secure compliance with existing NRC regulations, specifically General Design Criterion 17, Electric Power Systems (Appendix A to 10 CFR Part 50).

Response - NUMARC's comments on the backfit analysis were taken into account by the staff in revising the draft version of NUREG-1109, "Regulatory Backfit Analysis for the Resolution of Unreso I ved Safety Issue A-44, Station Blackout," and a separate appendix that addresses the factors in •50.109(c) was added to that report. All but Item 2 above are on the same subjects as letters from other commenters and are discussed in more detail under subjects

3 (Item 1), 6 (Item 4), 8 (Item 5), and 17 (Item 3) in this section. NUMARC's Item 2, the potential impact on radiological exposure of facility employees, would need to be assessed in detail only if it were a major factor in the value-impact analysis. The effect of radiological exposure on facility employees, if any, would be extremely small in comparison to the reduction in radiological exposure to the public from accident avoidance. Therefore, this factor would have no impact on the overall value-impact analysis.

Contrary to OCRE's and the Union of Concerned Scientists' comments, the Commission may subject the rulemaking process to internal controls. Moreover, the Commission is empowered to consider the costs of incremental safety improvements which go beyond the level of safety necessary to ensure no undue risk to the public health and safety. See UCS, et al., v. NRC, D.C. Cir. Nos. 85-1757 and 86-1219 (August 4, 1987). The improvements embodied in •50.63 go beyond the level of safety necessary to ensure no undue risk. Finally, contrary to the Union of Concerned Scientists' comment on GDC 17, new station blackout measures cannot be imposed on licensees as a matter of compliance with GDC 17, under the compliance exception in the backfit rule, paragraph 50.109(a)(4)(i). GDC 17 does not explicitly require that each plant be able to withstand station blackout for a specified time, or that each licensee perform a coping assessment and make whatever modifications may be necessary in the light of that assessment. Nor are any of these highly specific requirements logically compelled by any part of GDC 17. Moreover, GDC 17 has never been

[7590-01]

interpreted by the staff or the Commission to contain these specific requirements. Thus, to impose them under GDC 17 would amount to a backfit which resulted from a new staff and Commission interpretation of GDC 17.

The issue in this rulemaking is whether some additional protection is warranted beyond that already provided. The Commission is entitled to inquire, and seek public comment on, whether additional safety measures should be imposed where there is a substantial increase in the overall protection of public health and safety and the cost of implementation is justified in view of this increased protection.

3. Cost-Benefit Analysis and Whether •50.63 Meets the "Substantial Increase in the Overall Protection of the Public Health and Safety"

Chairman Zech and Commissioner Roberts requested comments on the analysis of cost benefit, value impact, and safety improvements and the station blackout standing on the overall risk (e.g., is the reduction of risk only a small percentage of the overall risk, or is it a major component of an already small risk?). Chairman Zech and Commissioner Roberts were particularly interested in specific comments assessing whether or not this proposal meets the "substantial increase in the overall protection of the public health and safety..." threshold now required by the backfit rule.

Comments - (A) One of the major comments by industry on the cost-benefit analysis was that the costs of implementing the proposed requirements have been underestimated. NUMARC and the Atomic Industrial Forum (AIF) commented that the cost estimates for hardware modifications reported in NUREG/CR-3840, "Cost Analysis for Potential Modifications To Enhance the Ability of a Nuclear Plant To Endure Station Blackout," were too low. Commonwealth Edison and other

utilities felt that performance of an analysis to determine the maximu
m
duration a nuclear plant could cope with a station bl'ackout would be
substantially costlier than what is estimated in NUREG-1109. Industry
also
expressed concern that the interpretations associated with the propose
d rule
could lead to substantial costs above those addressed by the NRC staff
in its

195

-17-
[7590-01]

backfit analysis. AIF commented that "The estimate of 12O NRC man-ho
urs per
plant [for NRC review] ... appears inadequate to account for technical
review
and evaluation of the determination of maximum coping capability and o
f the
description of station blackout procedures which the rule would requir
e each
licensee to submit."

(B) Several commenters expressed the view that the NRC failed to cons
ider all
the risks associated with a station blackout in its value-impact asses
sment.
The Union of Concerned Scientists thought independent failures, in add
ition to
failures that lead to a station blackout, should be included. One ind
ividual
stated that "both NRC reports [NUREG-1109 and NUREG-10321 are complete
ly
deficient in that neither look at sabotage." OCRE commented that seism
ic
events should also be considered.

(C) With respect to safety improvements and overall risk, different p
oints of
view were expressed. On one hand, NUMARC commented that, while the ri
sk
reduction might be large for a limited number of plants, the risk redu
ction
associated with the majority of plants will be small. Thus, as a gene
ral
matter, the reductions in risk offered by the proposed rule constitute
a small

percentage of the overall risk, a risk which is already small (and acc
eptable').
AIF stated that there is no standard by which to conclude that "substa
ntial
additional protection will be realized."

A different view was expressed by the Union of Concerned Scientists wh
o stated
that "station blackout is clearly a major component of the total risk
posed by
operating nuclear plants. The magnitude of the total risk is largely
unknowable due to the enormous uncertainty which surrounds probabilist
ic
assessments."

Response - (A) In order to adequately respond to industry's comments a
bove, the
staff and NRC contractors reviewed the cost estimates associated with
imple-
menting the station blackout rule. Based on this review, the estimate
d costs
for hardware modifications were reviewed and are in the range of from
20
percent to almost 140 percent greater than the estimates in NUREG/CR-3
840,

196

-18-
[7590-01]

depending on the specific modification considered. On average, the co
st
estimates for hardware backfit were found to be approximately 80 perce
nt
greater than estimated in NUREG/CR-3840. However, the cost estimates
in
NUREG/CR-3840 were not used by the staff in the value-impact analysis
in the
draft version of NUREG-1109 where estimates approximately 100 percent
greater
than the NUREG/CR-3840 estimates were used. Therefore, the revised co
st
estimates used in the final value-impact analysis are not significantl
y
different from the estimates used in the draft version.

Industry's comments on the costs to assess a plant's capability to cop
e with a

station blackout were based on the proposed rule that required an asse ssment of
the maximum coping capability and the potentially unbounded nature of such an
assessment. Based on public comments, the Commission has revised the final
rule to modify the requirement for licensees to determine the maximum coping
capability. (See response to public comments in subject number 9.) ins tead, a
coping assessment is required only for a specific duration. The cost for such
a study is estimated to be from 70 to 100 percent higher than the orig inal
estimates by the staff, and these revised costs are used in the final value-impact analysis.

The staff revised its estimate of the resource burden on NRC for revie w from
l2O to 175 person-hours per reactor. This revision was based on techn ical
review required for other comparable NRC activities.

(B) The technical analyses performed for USI A-44 indicated that the contribution to core damage frequency from independent failures, in ad dition to
failures that must occur to get to a station blackout, is low. Likewi se,
results of USI A-44 studies and other probabilistic risk assessments h ave shown
that, for station blackout sequences, the contribution to core damage frequency
from seismic events is low.

Not all events can be analyzed on a probabilistic bas is. Sabotage is an
example. Even though sabotage was not explicitly considered in the st aff's
value-impact analysis, it is discussed in NUREG-1109 under other

197

-19-
[7590-01]

considerations. These considerations support the conclusion that a st ation
blackout rule will provide a substantial safety benefit.

(C) The revised value-impact analysis performed for the resolution of USI A-44 indicates that there are substantial benefits in terms of reduced core damage frequency and reduced risk to the public that result from the station blackout rule, and the costs are warranted in light of these benefits. The best estimate for the overall value-impact ratio is 2,400 person-rem per million dollars. Even if those plants with the highest risk (and therefore the greatest risk reduction) were not considered, the value-impact ratio for the remaining plants is still favorable (i.e., about 1,500 person-rem per million dollars).

Analyses reported in NUREG-1150, "Reactor Risk Reference Document" (draft issued for comment in Februar 1987),4 indicate that station blackout is a dominant risk contributor to overall residual risk for most of the six plants analyzed. These results support the comment by the Union of Concerned Scientists in response to the Commissioner's request for comments on this subject.

4. Whether NRC Should Require Substantial Improvements in Safety that Go Beyond Those Proposed in this Rulemaking.

Commissioner Asselstine requested comments on whether the NRC should require substantial improvements in safety with respect to station blackout, like those being accomplished in some other countries, which can be achieved at reasonable cost and which go beyond those proposed in this rulemaking.

Comments - NRC received eight letters that included comments on this subject. Five of these were from the nuclear industry, none of which felt that the

198

-20-
[7590-01]

approach to station blackout taken in European countries should be used to justify safety improvements that go beyond the proposed •50.63. The main justification for industry's argument is that foreign countries may have reasons for requiring activities that differ from, or exceed, those in the U.S For example, Washington Public Power Supply Systems (WPPSS) commented, "It is not apparent that the details of U.S. grid stabilities and onsite power reliabilities are substantially similar enough to those found abroad to warrant a simple adoption of these [European] measures."

In another comment from industry on this subject, NUMARC stated that there are several reasons why many of the features for coping with a station blackout in new French nuclear power plants may already exist at most U.S. plants. In fact, they said, "The French approach to station blackout does not appear to depart significantly from current regulatory approaches in the U.S." Similarly, AlF stated, "The assertions of extensive station blackout coping capability at foreign (notably European) nuclear power plants are not sufficiently substantiated to serve as even part of the basis for the proposed requirements."

Three other letters (Union of Concerned Scientists, OCRE, and Illinois Department of Nuclear Safety) supported the NRC rulemaking to require all plants to be able to cope with a station blackout, but urged the Commission to go beyond the proposed rule. The Illinois Department of Nuclear Safety stated that:

The goal of holging the expected frequency of core damage from station blackout to 10 per reactor-year is not sufficiently stringent. With 7

relatively modest modifications to the proposed rule, a frequency of 1
0
appears achievable at reasonable cost. Specifically, the-rule should
require no less than 20 hours decay heat removal capacity instead of o
nly
four or eight hours in the proposed rule, in the event of a blackout.

Reponse - The staff agrees with industry's comments that foreign count
ries may
have valid reasons for imposing requirements that differ from or excee
d those
in the U.S. For example, it appears that there is a higher frequency o
f losses
of offsite power in France than in the U.S. This experience, along wit
h French
safety objectives, led the French to design their new standard nuclear
power

199

-21-
[7590-01]

plants to be able to cope with a very long duration station blackout (
i.e., up
to three days). The French safety approach and their station blackout
design
features are documented in NUREG-1206, "Analysis of French (Paluel) Pr
essurized
Water Reactor Design Differences Compared to Current U.S. PWR Designs,
" June
1986.

The Commission believes that the staff has adequately considered forei
gn
approaches in preventing core melt from station blackout in developing
the
resolution of USI A-44. Although the rule requires plants to be able
to cope
with station blackout for a specific duration, that duration is not sp
ecified
in the rule. Guidance to determine an acceptable duration is included
in
Regulatory Guide 1.155. This guidance should apply to most plants, but
if
there were adequate justification, different requirements (either more
or less
stringent than the regulatory guide) could be applied to specific plan
ts. The

use of alternate ac sources provides a means to achieve further increm ental
decreases in core melt frequency.

5. The Need for Generic Rulemaking

Comments - Five letters from the nuclear industry commented that gener ic
rulemaking is not necessary to resolve the station blackout issue. Th eir
reasons for this issue were as follows:

A generic rulemaking is inappropriate since the historic number of sit es
experiencing a loss of all offsite power is small. (Texas Utilities)

The station blackout issue should be handled on a plant-specific basis and
does not need to be resolved by generic rulemaking. Each plant has un ique
probability for a loss-of-power event based on transmission system, location of plant, and onsite power systems. (Duquesne Light)

The Commission need not pursue generic rulemaking in order to resolve a
non-generic issue. In the proposed station blackout rule, the number of
plants of concern is acknowledged to be limited. (NUMARC)

Station blackout has been found not to be a generic issue. Station blackout risk is plant specific and, according to the staff's own analyses, the proposal requirements are expected to result in modifications at no more than a few facilities, if at any. Requiring all

200

-22-
[7590-01]

licensees to undertake extensive analyses under the Provisions of the proposed rules when only a small group of plants may have a need for remedial action is not appropriate. (AIF)

Response - The Commission believes that a rule is appropriate to ensur e that
station blackout is addressed at all nuclear power plants. The plant-specific
features that contribute to risk for station blackout (e.g., diesel ge

nerator
configuration, probability of loss of offsite power) are considered by the
staff in the station blackout regulatory guide to determine an acceptable
coping duration for each plant. Even though not all sites have experienced a
loss of offsite power, there is not sufficient assurance that such events would
not occur in the future. Since historic experience has shown that a total loss
of offsite power occurs about once every 10 site-years, and many nuclear plants
have operated for less than 10 years, it is not surprising that some plants
have experienced a loss of offsite power while others have not.

Even though it is likely that many plants will not need hardware modifications
to comply with the rule, the assessment of station blackout coping capability
for a specific duration and implementation of associated procedures will effect
a safety benefit for all plants. The "limited number of plants of concern" in
NUMARC's letter refers to those plants having the highest risk from station
blackout (i.e., those that would need hardware modifications). Without a
plant-specific assessment, these plants can not be identified. Even excluding
these plants from consideration, the staff's analysis has shown that the
improvements in safety associated with the rule are consistent with backfit
considerations set forth in •50.109.

6. Applicability of the Proposed •50.63 to Specific Plants

Comments - Four letters included comments or questions regarding the
applicability of the rule to specific plants. For example, does the rule apply
to high-temperature gas-cooled reactors (HTGR) (i.e., Fort St. Vrain)? What
about TMI-2 or plants that are near completion but will not have an operating
license prior to the amendment's effective date? Houston Power and Lighting
Company wrote:

201

-23-
[7590-01]

Proposed Section 50.63 provides schedular guidance for implementing station blackout-related modifications on plants that already hold operating licensees or will be licensed to operate prior to the effective date of the amendment. Plants who may be NTOL's [near-term operating license] but will not be license prior to the amendment's effective date should be accorded the same compliance period under parts (c) and (d) of this section. Otherwise this proposed rule could be interpreted to imply that plants not licensed prior to the effective amendment date must comply with the rule and make all necessary modifications prior to receiving an O.L. [operating license'. The rule should be amended to address plants which are scheduled to receive an O.L. within a short time following implementation of this rule.

Response - Rather than identifying specific plants for which the rule does not apply, •50.63(a) specifies when it does apply (i.e., "each light-water-cooled nuclear power plant licensed to operate"). Since Fort St. Vrain is an HTGR, the generic rule would not apply. Station blackout will be considered individually for that plant based on its unique design. Since TMI-2 is not licensed to operate, likewise the rule would not apply to that plant. Any plant licensed to operate after the date the rule becomes effective will comply with the same 2,70-day schedule for information submittal applied to plants previously licensed. This affords NTOLs the same compliance features as plants already licensed to operate.

7. Plant-Specific Features and Capabilities

Comments - A number of utilities described plant-specific features and capabilities that reduced the risk posed by a station blackout event compared

to the staff's analysis. Examples of such features are given below.

øAvailability of alternate, independent ac power sources such as diesel generators, gas turbines, or nearby "black start" ac power sources.

øExtremely reliable offsite power supplies because of multiple right-of-ways or underground feeders to back up' above ground transmission lines.

øDedicated shutdown systems and associated diesel generators to meet the fire protection requirements of Appendix R tc 10 CFR Part 50.

202

-24-
[7590-01]

øCOmmon or shared systems between two units at multi-unit sites such as direct current (dc) Power, auxiliary feedwater, or diesel generators.

Response - The analyses performed for USI A-44 clearly show that plant-specific features do affect the risk from station blackout, and the station blackout regulatory guide takes this into account in providing guidance on different acceptable coping durations depending on the most significant of these features. Those plants with extremely reliable offsite and onsite ac power supplies need only have a very short (e.g., 2-hour) coping duration to be acceptable. Plants that have a dedicated shutdown system with its own independent power supply could take credit for this system to cope with a station blackout. The final rule and Regulatory Guide 1.155 have been clarified to give credit for alternate ac power supplies (see response to subject 11).

Therefore, the Commission believes that for almost all sites, plant-specific differences have been adequately accounted for in the resolution of USI A-44, but the door is open to licensees who believe their plants have additi

onal
capability that should be considered by the staff in demonstrating com pliance
with the rule.

8. The Source Term Used To Estimate Consequences

Comments - NUMARC and others in the industry commented that the conseq uences of
offsite releases that would result from a station blackout event are overestimated, and new source term information would lead to the predi ction of
much lower consequences for this event. Several commenters felt that the
approach taken by the staff to estimate consequences of a station blac kout
event was improper -- decreasing by a factor of three the estimated co nsequences
of the siting source term (SSTI) from NUREG/CR-2723, "Estimates of the Financial Consequences of Nuclear Power Reactor Accidents" (September 1982).

AIF felt that --implementation of any requirements resulting from the resolution
of USI A-44 should be deferred until the results of the source term re search

203

-25-
[7590-01]

can be taken into account." They based this statement on the premise that if
the consequences used in the staff's value-impact analysis were reduce d by a
factor of 10, none of the alternatives would be feasible.

The Union of Concerned Scientists expressed a different point of view in their
letter which said "... available evidence indicates that the consequen ces of an
accident involving station blackout may be even worse than those estim ated
either in WASH-1400 or the NRC's more recent studies."

Response - NRC has had an extensive research effort underway since abo ut 1981
to evaluate severe accident source terms. The staff has reviewed the

results
of this research to take into account the public comments received on this
subject. Since there is still a great deal of uncertainty regarding s ou rce
terms and associated consequences, the staff revised its value-impact analysis
for USI A-44 considering a range uf estimates for consequences of a st ation
blackout.

The NRC research on severe accident source terms has resulted in the d evelop-
ment of significant new analytical tools by NRC contractors, as discus sed in
NUREG-0956, "Reassessfiient of the Technical Bases for Estimating Sour ce Terms,"
July 1986. The analytical methods developed, generally referred to as the
Source Term Code Package (STCP), have been used to analyze a number of severe
accident sequences for five reference plants, namely: Peach Bottom, a BWk flark
I design; Sequoyah, a PWR ice condenser; Surry, a PWR with a sub-atmos pheric
containment; Grand Gulf, a BWR with a Mark III containment; and Zion, a PWR
with a large dry containment (NUREG-'Ll5O, "Reactor Risk Reference Doc ument,"
Draft for Comment, February 1987).

The results of these analyses show that releases from station blackout
sequences can be expected to vary significantly depending upon the pla nt and
the specific sequence. Although generalizations are difficult, it app ears that
calculations using the STCP yield release fractions for most of the se quences
range from about one third of an SSTI release (for the case of Surry, without

204

-26-
[7590-01]

condensation) to roughly one order of magnitude less than this. Howev er, the
uncertainties in our present understanding also do not preclude the Po

ssibility
of a large release, approaching that of the SSTI estimate.

To determine the consequences in terms of person-rem, given the above range of
release fractions, data taken from NUREG/CR-2723 indicate that the variations
in person-rem associated with releases of magnitude SST1, SST2 and SST3 are
virtually identical to the variations in latent cancer fatalities for the same
three releases. Hence, the estimated change in latent cancer fatalities with
release fractions provides a reliable indication of change in person-rem as
well.

Table 10 in NUREG/CR-2723 presents variations in estimated latent cancer
fatalities associated with changes in SST1 release fractions (for all elements
except noble gases). 'his 'a"e shows that a release fraction of one-third of
an SST1 release would yield a value of about 50 percent of the latent cancer
fatalities (and person-rem) of an SST1 release. Similarly, a release fraction
of one-third of an SSTI release would yield an estimated person-rem of about 15
percent of that associated with an SST1 release. Consequently, for value-
impact calculations, the staff estimated the range of consequences of station
blackout, in terms of person-rem, to be from 0.15 to 0.5 of the estimated
person-rem of an SST1 release. As noted, the original value-impact analysis
was based on 0.3 times the estimated person-rem of an SST1 release.

With regard to a possible delay in the resolution of USI A-44 until "better"
source terms become available, key considerations appear to be when better
source terms are likely to become available and to what degree uncertainties in
phenomenology as well as differences between investigators will be resolved.
Although research on source terms is expected to continue well into the future,
improvements in our knowledge are expected to be largely evolutionary beyond

this point, in that the major phenomena appear to have been accounted for, at
least in a first-order fashion, both in NRC as well as industry models.
Resolution and narrowing of the remaining uncertainties would also benefit from
improved experiments and analytical models that are likely to become available

205

-27-
[7590-01]

gradually. For these reasons, significantly better source terms than those
presently available are likely to be forthcoming only after a number of years.
Since the range of severe accident source terms and consequences suggested
above from estimating station blackout sequences is sufficiently broad to cover
likely improvements in source term knowledge, the resolution of USI A-44 should
not be delayed.

9. Specificity on the Extent of Required Coping Studies

Comments - Several letters by industry expressed concern that the studies
necessary to demonstrate that a plant can cope with a station blackout are not
well defined and could potentially be unbounded. These comments focused on two
main points. First, the proposed rule required plants to determine the maximum
duration the plant could cope with a station blackout, yet the draft regulatory
guide included specific guidance on acceptable coping durations (e.g., 4 or 8
hours). Determining the maximum duration, rather than assessing the plant's
capability for a specific acceptable duration, could be an open-ended
requirement. Along these lines, NUMARC stated:

Unless the required coping demonstration is specifically bounded by clearly stated definitions, assumptions, and criteria, there could conceivably be hundreds of supporting special effects analyses which licensees may have to consider as a result of the exercise of discreti

on
by individual staff reviewers. Under the rule as proposed, licensees cannot ascertain the ultimate requirements they will be expected to meet (including the potential plant modifications they will need to make) to demonstrate compliance.

Second, industry also commented on the potential open-endedness of analyses to determine the operability of equipment in environmental conditions resulting from a station blackout (e.g., without heating, ventilation, and air conditioning). Unless these analyses were well defined, industry felt the analyses could be much more costly than estimated by the staff. However, NUMARC made the following statement relating to the need for detailed prescriptive require-ments by NRC that appears to contradict their earlier statement.

206

-28-
[7590-01]

The point .... is not that regulations must be prescriptive by their very nature. Prescriptive reguations, which outline in detail exactly what steps are required by licensees to satisfy a proposed regulation, are, in many instances, unnecessary and counterproductive.

Response - With regard to the proposed requirement that each plant determine its maximum duration for coping with station blackout, the staff agrees with the industry comments. First of all, it would be difficult to adequately define "maximum duration" in this sense. Second, if licensees determine that their plants can cope with a station blackout for a specified duration and restore ac power through an acceptable coping analysis, the additional safety benefit gained from simply the knowledge that a longer, or maximum duration," coping duration exists is small. Third, the costs for assessing "maxi

mum
duration" will be higher since more extensive analyses will be require d to
analyze a transient which would go beyond the coping analysis for a sp ecified
duration and recovery from station blackout. Therefore, the rule and
regulatory guide have been revised accordingly to delete the requireme nt for
licensees to determine a plant's maximum coping capability.

With regard to the comments on assessments to determine equipment oper ability
during a station blackout, the staff feels strongly that such assessme nts are
necessary to determine a plant's response to station blackout. By del eting the
requirement to determine a plant's "maximum" coping capability, the as sessment
of equipment operability would not be as costly as assumed by industry .
Guidance on acceptable coping assessments is provided in the station b lackout
regulatory guide. Also, guidelines to evaluate the effects of loss of
ventilation under station blackout conditions are provided in Appendix E of
NUMARC-8700, "Guidelines and Technical Bases for NUMARC Initiatives Ad dressing
Station Blackout at Light Water Reactors." These efforts provide addit ional
definitions, criteria, and standards for licensees' assessments of equ ipment
operability without the need for "prescriptive regulations" by NRC.

In order to further evaluate industry's comments on this subject, NRC requested
Sandia National Laboratories to identify specific tasks necessary to d etermine
operability of equipment during a station blackout and to estimate the cost to

207
-29-
[7590-01]

perform these tasks. Results of this study were used in the revised v alue-
impact analysis performed for this issue ("Equipment Operability Durin g Station
Blackout Events," NUREG/CR-4942).

10. Acceptable Duration for Coping with a Station Blackout

Comments - Several comments with differing views were directed at guidance in the draft regulatory guide on acceptable station blackout coping durations in order for plants to comply with the proposed rule.

Washington Public Power Supply commented that "it should be Possible for certain utilities to demonstrate [an acceptable] zero hour blackout.,' One individual recommended "that a 30 minute period be a margin, and that no duration under 4 hours be accepted by the staff." NucleDyne Engineering commented that "advanced reactors should require the capability to safely withstand a station blackout of at least 8 hours," and the Illinois Department of Nuclear Safety wrote that "the rule should require no less than 20 hours decay heat removal capability instead of only 4 or 8 hours."

Response - Although diverse comments were received on this subject, none provided supporting analysis or information to back up the opinions expressed. However, the staff did reanalyze the estimated risk from station blackout events for different plant- and site-related characteristics and revised its guidance on acceptable coping durations accordingly based on a goal of limiting the average contribution to core damage from station blackout to about 10-5 per reactor-year. Most plants would still need a 4- or 8-hour coping capability. Those few plants with the most redundant onsite emergency ac power system, coincident with significantly lower than average expected frequency of loss of offsite power, would need only a 2-hour capability to be acceptable. Any plant with minimum redundancy in the onsite emergency ac power system coincident with low reliability and a significantly higher than average expected frequency of loss of offsite power would need to substantially improve its ac power reliability or be able to cope with a station blackout for 16 hours.

208

-30-
[7590-01]

11. Credit for Alternate or Diverse AC Power Sources

Comments - Ten letters from the utility industry commented that more credit should be allowed for the availability of alternate power sources such as onsite gas turbines. The comments below represent the utilities' viewpoint.

The station blackout rule should be clarified to allow credit for diverse and very reliable offsite power sources or diverse and very reliable onsite electrical generation. (Public Service Company of Colorado)

The option of providing an additional alternate source of ac power is eliminated by [the proposed resolution]. The inconsistency in this approach can best be understood by considering an example at a generic nuclear power station. (Toledo Edison)

If the licensee were to provide an additional independent diesel generator capable of providing the necessary ac power to prevent station blackout, the licensee ... would still be required to withstand at least 4 hours without ac power. They would receive no credit for the additional diesel generator in the coping analysis. If the licensee were to use that same diesel engine to power a charging pump, even though it would be of less significance to mitigation of reactor core damage than the diesel generator, the licensee could take credit for it in coping with the blackout. (Toledo Edison)

Since a diesel-powered charging pump will not provide for equipment loading flexibility, lighting, ventilation, instrumentation, etc., it is obviously of lower value than an additional source of ac power. The fixed category approach taken in [the proposed resolution], however, will not permit taking credit for the same diesel engine when used as a generator though the actual reliability for the machine is the same. (Toledo Edi

son)

Response - The proposed regulation did not intend to ignore the alternative of adding additional power sources or taking credit for such sources if they already exist. For example, as specified in the regulatory guide, if a licensee added an emergency diesel generator to one of its plants that had minimum redundancy in the onsite emergency ac power sytem, the acceptable station blackout coping duration could be reduced. For some plants, however, adding a diesel generator would not result in a reduction in the acceptable coping duration, and the point made by Toledo Edison is a valid one. The rule and regulatory guide have been revised to clarify that alternate ac power sources are given credit to cope with a station blackout provided that certain

209

criteria are met (e.g., independence, redundancy, high reliability, maintenance, and testing).

12. Trends on the Reliability of AC Power Sources

Comments - Five letters included comments on the reliability of ac power sources. Four letters from industry felt that improved ac power reliability should be factored into the staff's technical analysis. Examples of these comments include the following:

"... the frequency of loss of offsite power activities has been decreasing... " (Washington Public Power Supply System);

" ... offsite power availability in the absence of regulation has significantly improved over the past decade." (Southern California Edison Company);

"[NUREG/CR-4347] ... shows an improvement in diesel generator reliabil

ity
over that shown in the earlier document [NUREG/CR-2989]." (General Electric); and

"Typically the reliability of onsite power systems increases during th e
first few years following startup." (Gulf States Utilities)

The Illinois Department of Nuclear Safety, on the other hand, felt tha t
potential vulnerabilities still exist in onsite emergency ac power sys tems, and
licensees should demonstrate that they have taken steps to reduce the probability of loss of ac power.

Response - The staff and its contractors have extensively analyzed the industry
experience and trends in ac power reliability as documented in NUREG-1 032,
NUREG/CR-2989, NUREG/CR-3992, and NUREG/CR-4347. Trends have shown th at two
aspects of ac power reliability have improved somewhat -- the reduced frequency
of losses of offsite power due to plant-centered events, and a slight improvement in average diesel generator reliability from 1976 through 1983.
These factors have been taken into account in the staff's analyses and the
resolution of USI A-44. However, data also demonstrate that there are practical limits on ac power reliability, and the defense-in-depth app roach of
being able to cope with a station blackout is warranted.

210

-32-
[7590-01]

13. Sharing of Emergency Diesel Generators Between Units at Multi-Uni t Sites

Comments - Several letters from industry stated that some plants with two units
on a site have the capability to crosstie electrical buses between uni ts and
therefore have improved flexibility in providing ac power. Since the magnitude
of the electrical loads necessary to provide core cooling during a sta tion

blackout is significantly less than that required for a design basis a ccident,
it could be possible to provide ac power to both units at the site usi ng only a
single diesel generator.

Response - The proposed rule and draft regulatory guide do not prohibi t the
approach discussed above. If licensees can demonstrate that such cros stie
capability exists, procedures are in place to accomplish the crosstie and shed
nonessential loads (if necessary), and no NRC regulations are viola te d (such as
separation, minimum redundancy, and independ ence), then credit would be given
for this capability as shown in Regulatory Guide 1.155 (i.e., reduced acceptable station blackout coping durations for greater diesel genera tor
redundancy).

14. Clarification of the Definitions of Station Blackout and Diesel G enerator
Failures

Comments - (A) Three commenters from the utility industry recommended that the
definition of station blackout in •50.2 should be clarified to exclude ac power
from the station batteries through inverters. This source of ac power from the
station batteries would be available in the event of a loss of both th e offsite
and onsite emergency ac power sources (i.e., diesel generators).

(B) Several from industry commented that the definition of diesel gen erator
failure should be clarified, particularly with respect to the treatmen t of
short-term failures that can be recovered quickly. Sargent and Lundy Engineers
commented that:

211

-33-
[7590-01]

A definition of failure on demand for emergency diesel generators need

s to
be provided. Under the context of a station blackout, a diesel genera tor
which fails to start automatically upon detection of an offsite power loss, but is successfully started manually from the main control room or
from the local control panel, should not be considered a failure on demand.

Response - (A) The staff agrees with comment A and revised the definit ion of
station blackout accordingly.

(B) Based on actual experience, failures of diesel generators to star t due to
failures in the auto-start system make up less than 20 percent of all diesel
generator failures. Therefore, discounting these failures would not h ave a
significant impact on overall diesel generator reliability statistics. However,
the staff agrees in principle with comment B and has clarified the sta tion
blackout regulatory guide so that auto-start failures of diesel genera tors need
not be counted in determining the failure rate if the diesel generator is
capable of being started manually immediately after it does not start automatically.

15. Specificity and Clarification of Requirements

Comments Public comments were received regarding the specificity and clarifi-
cation of the proposed rule and draft regulatory guide. These ranged from
general to specific comments as the following two excerpts indicate:

We are concerned that, if the proposed rule is adopted, the staff will promulgate regulatory guidance criteria which will be unrealistic and excessive, i.e., compounding the event with other accidents, imposing passive failure criteria, applying seismic, environmental qualificatio n
and other qualifications to equipment that could otherwi se be used in response to such an event, etc. (Maine Yankee Atomic Power Company)

Definitions of PI and P2 [in Table 3 of the draft Regulatory Guide] us e
frequency of extremely severe weather and severe weather interchangeab ly,
thus creating con usion in the definition. (Washington Public Supply

System)

Response - Some of the comments on this subject relate to other subjec ts
discussed elsewhere in this section. Some comments were quite specifi c while
others were general in nature or expressed views that were not substan tiated

212
-34-
[7590-01]

With backup material- The staff has taken these comments into consider ation
and revised and clarified the rule and regulatory guide accordingly. Additional
guidance is provided in NUMARC-8700 which has been reviewed by the sta ff and
referenced in the regulatory guide as providing a method the staff fin ds
acceptable for meeting the rule.

16. Technical Comments on NUREG-1032

Comments - In addition to comments on the proposed rule and draft regu latory
guide, several letters contained comments on the staff's draft technic al
report, NUREG-1032, "Evaluation of Station Blackout Accidents at Nucle ar Power
Plants."

Response - NUREG-1032 was issued in draft form for public comment in M ay 1985
(50 FR 24332). The comments received were reviewed and considered by the staff
and resulted in a re-evaluation of the technical analysis. Details of the
specific comments and responses are not presented here. Rather, NUREG -1032 was
revised extensively over the past year to address the public comments. In
general, the overall conclusions on the risk from station blackout eve nts aid
not change significantly as a result of the reanalysis. One of the ma jor
changes resulting from the reanalysis was a revision to the definition s of

plant characteristics, especially the clustering of plants into site a
nd
weather-related groups (Appendix A in NUREG-1032). These changes are
reflected
in revisions to the guidance in the station blackout regulatory guide
to
determine plant-specific acceptable station blackout coping durations.

17. Relationship of USI A-44 to Other NRC Generic Issues

Comments - The major public comment regarding the relationship of USI
A-44 to
other NRC generic safety issues was that the proposed rule may not be
necessary
or should be postponed because of ongoing work to resolve related gene
ric
issues. Some comments were general in nature such as the following on
e from
Southern California Edison Company:

213

-35-
[7590-01]

Promulgation of a final station blackout rulemaking at this time will
unnecessarily complicate the final resolution of related generic techn
ical
issues .... The NRC must develop and implement a program to coordinat
e the
resolution of all Power-related generic issues prior to finalizing any
Individual proposed rule.

AIF suggested that the implementation of any requirements for station
blackout
be deferred until the requirements from USI A-45, Shutdown Decay Heat
Removal
Requirements, are known and until the effect of source term changes ca
n be
evaluated.

NUMARC mentioned specific proposed and existing regulatory requirement
s that
should be considered because they could reduce the need for a station
blackout
rule (e.g., B-56, Diesel Generator Reliability, and GI 23, Reactor Coo
lant Pump
Sea] Failures). Other related issues mentioned in the public comments
were

A-30, Adequacy of Safety-Related DC Power Supplies, and implementation of safe
shutdown facilities to meet the fire protection requirements of Appendix R.

Response - The question that needs to be addressed is "should a requirement be
imposed now to reduce risk, or should it be postponed until related issues are
resolved sometime in the future?" Potentially, this could result in substantial delays, thereby not resolving generic safety issues in a t imely
manner. The staff has considered the resolution of USI A-44 in light of the
related issues mentioned in the comments. Although these issues are identified
as separate tasks within NRC, they are all managed in a well established
program that coordinates all related issues. A brief discussion of the most
relevant issues is presented below. (Additional information is provided in
NUREG-1109, "Regulatory Analysis for the Resolution of Unresolved Safety Issue
A-44, Station Blackout.")

Resolution of USI A-45 will occur at some time following issuance of the
station blackout rule (•50.63) and after plant-specific station blackout coping
evaluations have been performed by licensees per NUMARC/NUGSBO Initiative 5,
utilizing guidelines provided in NUMARC-8700. Further, the resolution of USI
A-45 is expected to be highly plant-specific and focused on loss of decay heat
removal considerations from other cause s beyond station blackout. Utilization
will be made of A-44 evaluations (as applicable) and any plant equipment

214

-36-
[7590-01]

modification needs identified from A-45 will be carefully evaluated to maximize

effective use of previously identified A-44 equipment needs.

Maintaining emergency diesel generator reliability, the purpose of B-56, is an integral part of the resolution of USI A-44. However, the Commission believes that additional defense-in-depth will achieve a substantial increase in protection to public health and safety.

The resolution of GI 23 (reactor coolant pump seal leakage) deals with loss of reactor coolant system inventory and associated degraded core conditions. USI A-44 deals with station blackout induced effects, which result in loss of ac power, thereby impacting a broader spectrum of plant equipment and safety-related functions. Although the resolution of GI 23 will contribute to establishing a higher level of assurance that seal leakage will be minimized (thereby minimizing the need for power to replace water inventory losses over the station blackout duration and recovery phase), resolution of GI 23 by itself will not address the broader scope of USI A-44 safety concerns.

Some licensees have implemented dedicated shutdown systems that are independent of normal and emergency ac power to meet Appendix R requirements. If applicable, these features would be credited in the resolution of USI A-44 by providing the capability to cope with a station blackout.

Thus, the resolution of USI A-44 is coordinated with related generic issues, and implementation of a final resolution should not be delayed further.
(Response to comments on the effect of source term changes is included in subject number 8.)

18. An Alternative of Plant-Specific Probabilistic Assessments

Comments - Several utilities suggested that, in lieu of the requirements in the rule, licensees should be permitted to submit plant-specific evaluations to demonstrate that the frequency of core damage from station blackout ev

ents is
10-5 per reactor-year or less. In a similar vein, the suggestion was made that

215

-37-
[7590-01]

NRC should specify a target level of reliability for ac power systems in order
to satisfy NRC's criteria for core damage frequency. A few licensees submitted
limited probabilistic assessments to show that for some plants station blackout
could have a very small probability of severe consequences.

Response - The Commission does not preclude licensees from submitting plant-
specific probabilistic assessments to support a determination that station
blackout would have a very small probability for causing core damage. However,
the requirements of the rule must be met. The Commission would observe that
the use of probabilistic assessments was important as input to the regulatory
decisionmaking that culminated in the station blackout rule and related
guidance. As expressed in the Commission's Safety Goal Policy statement of
August 1986 (51 FR 28044), the Commission has acquired a reasonable degree of
confidence about the usefulness and value of probabilistic assessments in
assisting regulatory decisionmaking on complex safety issues. In short, such
assessments are of value in complementing and focusing the more traditional and
deterministic defense-in-depth approaches. On the other hand, any licensee
must decide whether or not its plant-specific ac power configuration and other
related equipment are sufficiently unique to merit the conduct and submittal of
a probabilistic assessment as part of achieving compliance to •50.63. The
Commission's experience also indicates that probabilistic assessments are

resource intensive and can be of marginal utility if their only end re
sult is
to delay rule compliance.

19. Procedures and Operator Actions During Station Blackout

Comments - (A) Several letters from industry commented that, in respon
se to
Generic Letter 81-04, "Emergency Procedures and Training for Station B
lackout
Events," dated February 21, 1981, utilities already have procedures in
 place to
prepare plant operations for station blackout events. Owners' groups
have
established generic guidance for station blackout operating procedures
 for
licensees to use in developing plant-specific procedures. A represent
ative of
the Professional Reactor Operator Society commented that:

216

-38-
[7590-01]

Generic procedures are used by most operating facilities. These
procedures are not carried into adequate depth of specific power plant
operations. The industry has relied too heavily on generic procedures
 and
has not given a real look at what specific steps must be taken.
Extrapolation of these procedures must be required. Specific maintena
nce
procedures must be established and followed.

(B) Other comments on procedures related to the timeliness of operator
 actions,
both inside and outside the control room. Houston Lighting and Power
suggested
that:

In Section 3.1 (Part 6) [of the regulatory guide], the first sentence
should be revised to read, 'Consideration should be given to timely
operator actions both i side and utside of the control room that ... s
o
that credit can e taker list ng equipment that may not have
actuation and control from the control room.

Illinois Power Company recommended that:

... Section C.3.3, Item 3.a, of the proposed regulatory guide should be
modified to read:

a. The system should be capable of being actuated and controlled from the control room, or if other means of control are required (e.g., manual jumping of control logics or manual operation of valves), it should be demonstrated that these steps can be carried out in a timely fashion.

Response - (A) Licensees may take credit for station blackout procedures
already in place to comply with the station blackout rule. However, for the
most part, these procedures were developed without having the benefit of a
plant-specific assessment to determine whether a plant could withstand a
station blackout for a specific duration. Therefore, these procedures may need
to be modified after licensees have determined an acceptable station blackout
coping duration and evaluated their plant's response to a station blackout of
this duration.

(B) The staff agrees with the comments related to operator actions outside the
control room, and the regulatory guide was revised accordingly.

217

-39-
[7590-01]

20. Schedule Provisions in the Proposed •50.63

Comments - Two letters contained comments on the proposed schedule in •50.63.
OCRE felt the scheduling provisions in the proposed rule were far too generous.
One individual recommended that the schedule be modified to require licensees
to submit, within 9 months of the date of the amendment, a list of modifications along with a proposed schedule to implement those modifications.
(According to the proposed rule, licensees would not have to submit a schedule
for implementing equipment modifications until after the staff receive

d and
reviewed licensees' submittals on their plant's acceptable station bla
ckout
duration.)

Response - The staff agreed in part with these comments, and the sched
ule was
revised accordingly. Section 50.63(c)(1)(iii) now requires that licen
sees
submit within 9 months after the rule is issued a list of equipment
modifications and a proposed schedule for implementing them. A final
schedule
would be developed after NRC has reviewed the licensees' submittal of
their
plant's acceptable station blackout duration.

21. Industry Initiatives

Comments - In addition to comments on the proposed rule, NUMARC endors
ed the
following five initiatives 5 to address the more important contribut
ors to
station blackout:

1. Each utility will review their site(s) against the criteria specif
ied
in NUREG-1109, and if the site(s) fall into the category of an
eight-hour site after utilizing all power sources available, the
utility will take actions to reduce the site(s) contribution to the
overall risk of station blackout. Non-hardware changes will be made
within one year. Hardware changes will be made within a reasonable
time thereafter.

NUMARC initially proposed a set of four initiatives. The fifth initia
tive
regarding the performance of a coping assessment was provided in
NUMARC-8700, which was submitted by letter from J. Opeka (NUMARC) to
T. Speis (RES) aated November 23, 1987. A copy is available for publ
ic
inspection and copying for a fee at the NRC Public Document Room at
1717 H Street NW., Washington, DC.

218

-40-
[7590-01]

2. Each utility will implement procedures at each of its site(s) for:

a. coping with a station blackout event

b. restoration of ac Power following a station blackout event, and

c. preparing the plant for severe weather conditions (e.g., hurricanes and tornados) to reduce the likelihood and consequences of a loss of offsite power and to reduce the overall risk of a station blackout event.

3. Each utility will, if applicable, reduce or eliminate cold fast-st arts of emergency diesel generators for testing through changes to technical specifications or other appropriate means.

4. Each utility will monitor emergency ac power unavailability utiliz ing data utilities provide to INPO on a regular basis.

5. Each utility will assess the ability of its plant(s) to cope with a station blackout. Plants utilizing alternate AC power for station blackout response which can be shown by test to be available to power the shutdown busses within 10 minutes of the onset of station blackout do not need to perform any coping assessment. Remaining alternate AC plants will assess their ability to cope for. I hour- Plants not utilizing an alternate AC source will assess their ability to cope for 4 hours. Factors identified which prevent. demonstrating the capability to cope for the appropriate du ration will be addressed through hardware and/or procedural changes so that successful demonstration is possible.

NUMARC previously opposed generic rulemaking and felt that the first f our initiatives would resolve the station blackout issue.

Response - These five initiatives now include many of the elements tha t are included in the NRC resolution of USI A-44. The staff has followed up on the NUMARC initiatives through a series of meetings in 1986 through 1987. The result has been the development of NUMARC-8700 which provides guidelin es and criteria acceptable to the staff. The procedures in NUMARC-8700 have been referenced in Regulatory Guide 1.155 as providing guidance acceptable to the staff for meeting the requirements of the rule. Table I in Regulatory Guide 1.155 provides a cross-reference to NUMARC-8700 and notes where the re

gulatory
guide takes precedence. NUMARC's previous concerns have been addresse d in the
development of Regulatory Guide 1.155 and NUMARC-8700.

219

-41-
[7590-01]

Finding of No Significant Environmental Impact: Availability

The Commission has determined under the National Environmental Policy Act of
1969, as amended, and the Commission's rules in Subpart A of CFR Part 51, that
this rule is not a major Federal action significantly affecting the qu ality of
the human environment, and therefore, an environmental impact statemen t is not
required. There are not any adverse environmental impacts as a result of the
rule because there is no additional radiological exposure to the gener al public
or plant employees, and plant shutdown is not required so there are no additional environmental impacts as a result of the need for replaceme nt power.
The environmental assessment and finding of no significant impact on w hich this
determination is based are available for inspection and copying for a fee at
the NRC Public Document Room 1717 H Street, NW, Washington, DC. Singl e copies
of the environmental assessment and the finding of no significant impa ct are
available from Mr. Warren Minners, Office of Nuclear Regulatory Resear ch, U. S.
Nuclear Regulatory Commission, Washington, DC 20555, Telephone:
(301) 492-7827.

Paperwork Reduction Act Statement

This final rule amends information collection requirements that are su bject to
the Paperwork Reduction Act of 1980 (44 U.S.C. 3501 et seq). These requirements were approved by the Office of Management and Budget appr oval
number 3150-0011.

Regulatory Analysis

The Commission has prepared a regulatory analysis on this final regulation. The analysis examines the costs and benefits of the alternatives considered by the Commission. A copy of the regulatory analysis, NUREG-1109, "Regulatory/ Backfit Analysis for the Resolution of Unresolved Safety Issue A-44, Station Blackout," is available for inspection and copying for a fee at the NRC Public Document Room. 1717 H Street, NW, Washington, DC 20555.

220
-42-
[7590-01]

Regulatory Flexibility Certification

As required by the Regulatory Flexibility Act (5 U.S.C. 605(b)), the Commission certifies that this rule does not have a significant economic impact on a substantial number of small entities. The rule requires that nuclear power plants be able to withstand a total loss of ac power for a specified time duration and maintain reactor core cooling during that period. These facilities are licensed under the provisions of ••50.21(b) and 50.22 of 10 CFR Part 50. The companies that own these facilities do not fall within the scope of "small entities" as set forth in the Regulatory Flexibility Act or the small business size standards set forth in regulations issued by the Small Business Administration in 13 CFR Part 121.

List of Subjects in 10 CFR Part 50

Antitrust, Classified information, Fire prevention, Incorporation by reference, Intergovernmental relations, Nuclear power plants and reactors, Penalty, Radiation protection, Reactor siting criteria, Reporting and recordkeeping requirements.

For the reasons set out in the preamble and under the authority of the Atomic Energy Act of 1954, as amended, the Energy Reorganization Act of 1974, as amended, and 5 U.S.C. 553, the NRC is adopting the following amendments to 10 CFR Part 50.

Part 50 - Domestic Licensing of Production and Utilization Facilities

1. The authority citation for Part 50 is revised to read as follows:

AUTHORITY: Secs. 102, 103, 104, 105, 161, 182, 183, 186, 189, 68 Stat. 936, 937, 938, 948, 953, 954, 955, 956, as amended, sec. 234, 83 Stat. 1244, as amended (42 U.S.C. 2132, 2133, 2134, 2135, 2201, 223Z, 2233, 2236, 2239, 2282); secs. 201, as amended, 202, 206, 88 Stat. 1242, as amended, 1244, 1246 (42 U.S.C. 5841, 5842, 5846).

221

-43-
[7590-01]

Section 50.7 also issued under Pub. L. 95-601 sec. 10, 92 Stat. 2951 (42 U.S.C. 5851). Sections 50.10 also issued under secs. 101, 185, 68 Stat. 936, 955, as amended (42 U.S.C. 2131, 2235); sec. 102, Pub. L. 91-190, 83 Stat. 853 (42 U.S.C. 4332). Sections 50.23, 50.35, 50.55, and 50.56 also issued under sec. 185, 68 Stat. 955 (42 U.S.C. 2235). Sections 50.33a, 50.55a and Appendix Q also issued under sec. 102, Pub. L. 91-190, 83 Stat. 853 (42 U.S.C. 4332). Sections 50.34 and 50.54 also issued under sec. 204, 88 Stat. 1245 (42 U.S.C. 5844). Sections 50.58, 50.91, and 50.92 also issued under Pub. L. 97-415, 96 Stat. 2073 (42 U.S.C. 2239). Section 50.78 also issued under sec. 122, 68 Stat. 939 (42 U.S.C. 2152). Sections 50.80-50.81 also issued under sec. 184, 68 Stat. 954, as amended (42 U.S.C. 2234). Section 50.103 a

lso
issued under sec. '08, 68 Stat. 939, as amended (42 U.S.C. 2138). Ap
pendix F
also issued under sec. 187, 68 Stat. 955 (42 U.S.C. 2237).

For the purposes of sec. 223, 68 Stat. 958, as amended (42 U.S.C. 2273
);
••50.10(a), (b), and (c), 50.44, 50.46, 50.48, 50.54, and 50.80(a) are
issued
under sec. 161b, 68 Stat. 948, as amended (42 U.S.C. 2201(b)); ••50.10
(b) and
(c), and 50.54 are issued under sec. 161i, 68 Stat. 949, as amended (4
2 U.S.C.
2201(i)); and ••50.9, 50.55(e), 50.59(b), 50.70, 50.71, 50.729 50.73,
and 50.78
are issued under sec. 161o, 68 Stat. 950, as amended (42 U.S.C. 2201(o
)).

2. In •50.2, definitions of "alternate ac source" and "station bla
ckout"
are added in the alphabetical sequence to read as follows:

•50.2 Definitions

"Alternate ac source,, means an alternating current (ac) power source
that is
available to and located at or nearby a nuclear power plant and meets
the
following requirements:

(1) Is connectable to but not normally connected to the offsite
or onsite emergency ac power systems;

(2) Has minimum potential for common mode failure with offsite
power or the onsite emergency ac power sources;

(3) Is available in a timely manner after the onset of station
blackout; and

(4) Has sufficient capacity and reliability for operation of all
systems required for coping with station blackout and for the
time required to bring and maintain the plant in safe shutdown
(non-design basis accident).

222
-44-
[7590-01]

"Safe shutdown (non-design basis accident (non-DBA))" for station blac
kout

means bringing the plant to those shutdown conditions specified in pla nt technical specifications as Hot Standby or Hot Shutdown, as appropriat e (plants have the option of maintaining the RCS at normal operating temperature s or at reduced temperatures).

"Station blackout" means the complete loss of alternating current (ac) electric power to the essential and nonessential switchgear buses in a nuclear power plant (i.e., loss of offsite electric power system concurrent with tur bine trip and unavailability of the onsite emergency ac power system). Station blackout does not include the loss of available ac power to buses fed by statio n batteries through inverters or by alternate ac sources as defined in t his section, nor does it assume a concurrent single failure or design basi s accident. At single unit sites, any emergency ac power source(s) in e xcess of the number required to meet minimum redundancy requirements (i.e., sin gle failure) for safe shutdown (non-DBA) is assumed to be available and ma y be designated as an alternate power source(s) provided the applicable req uirements are met. At multi-unit sites, where the combination of emergency ac p ower sources exceeds the minimum redundancy requirements for safe shutdown (non-DBA) of all units, the remaining emergency ac power sources may be used as alternate ac power sources provided they meet the applicable requirements. If t hese criteria are not met, station blackout must be assumed on all the unit s.

3. A new •50.63 is added to read as follows:

•50.63 Loss of all alternating current power.

(a) Requirements. (1) Each light-water-cooled nuclear power plant lic ensed to operate must be able to withstand for a specified duration and reco ver from a station blackout as defined in •50.2. The specified station blackout duration shall be based on the following factors:

223

-45-
[7590-01]

(i) The redundancy of the onsite emergency ac power sources;
(ii) The reliability of the onsite emergency ac Power sources;
(iii) The expected frequency of loss of offsite power; and
(iv) The probable time needed to restore offsite power.

(2) The reactor core and associated coolant, control, and protection systems, including station batteries and any other necessary support systems, must provide sufficient capacity and capability to ensure that the core is cooled and appropriate containment integrity is maintained in the event of a station blackout for the specified duration. The capability for coping with a station blackout of specified duration shall be determined by an appropriate coping analysis. Utilities are expected to have the baseline assumptions, analyses, and related information used in their coping evaluations available for NRC review.

(b) Limitation of Scope. Paragraphs (c) and (d) of this section do not apply to those plants licensed to operate prior to , if the capability to withstand station blackout was specifically addressed in the operating license proceeding and was explicitly approved by the NRC.

(c) Implementation. (1) Information Submittal: For each light-water-cooled nuclear power plant licensed to operate on or before the licensee shall submit the information defined below to the Director of the Office of Nuclear Reactor Regulation by For each light-water-cooled nuclear power plant licensed to operate after the effective date of this amendment, the licensee shall submit the information defined below to the Director by 270 days after the date of license issuance.

(i) A proposed station blackout duration to be used in determining

compliance with paragraph (a) of this section, including a justification for the selection based on th e four factors identified in paragraph (a) of this section;

224

-46-
[7590-01]

(ii) A description of the procedures that have been established for station blackout events for the duration determined in paragraph (c)(1)(i) of this section and for recovery therefrom; and

(iii) A list of modifications to equipment and associated procedures, if any, necessary to meet the requirements of paragraph (a) of this section, for the specified station blackout duration determined in paragraph (c)(1)(i) of this section, and a proposed schedule for implementing the stated modifications.

(2) Alternate ac source: The alternate ac power source(s), as defined in •50.2, will constitute acceptable capability to withstand station blackout provided an analysis is performed which demonstrates that the plant has this capability from onset of the station blackout until the alternate ac source(s) and required shutdown equipment are started and lined up to operate. The time required for startup and alignment of the alternate ac power source(s) and this equipment shall be demonstrated by test. Alternate ac source(s) serving a multiple unit site where onsite emergency ac sources are not shared between units must have, as a minimum, the capacity and capability for coping with a station blackout in any of the units. At sites where onsite emergency ac sources are shared between units, the alternate ac source(s) must have the capacity and capability as required to ensure that all units can be brought to and maintained in safe shutdown (non-DBA) as defined in •50.2. If the alternate ac source(s) meets the above requirements and can be demonstrated by test to be available to power the shutdown buses within 10 minutes of

the onset
of station blackout, then no coping analysis is required.

(3) Regulatory Assessment: After consideration of the information submitted
in accordance with paragraph (c)(1) of this section, the Director, Office of
Nuclear Reactor Regulation, will notify the licensee of the Director'-
conclusions regarding the adequacy of the proposed specified station blackout
duration, the proposed equipment modifications and procedures, and the proposed

225

-47-
[7590-01]

schedule for implementing the procedures and modifications for compliance with
paragraph (a) this section.

(4) Implementation Schedule: For each light-water-cooled nuclear power plant
licensed to operate on or before , the licensee shall,
within 30 days of the notification provided in accordance with paragraph (c)(3)
of this section, submit to the Director of the Office of Nuclear Reactor
Regulation a schedule commitment for implementing any equipment and associated
procedure modifications necessary to meet the requirements of paragraph (a) of
this section. This submittal must include an explanation of the schedule and a
justification if the schedule does not provide for completion of the
modifications within two years of the notification provided in accordance with
paragraph (c)(3) of this section. A final schedule for implementing
modifications necessary to comply with the requirements of paragraph (a) of
this section will be established by the NRC staff in consultation and
coordination with the affected licensee.

Dated at Rockville, Maryland, this ----- day of--------- 1988.

For the Nuclear Regulatory Commission.

Samuel J. chilK,
Secretary of the Commission.

226

-48-
[7590-01]

BACKFIT ANALYSTS

Analysis and Determination That the Rulemaking To Amend 10 CFR 50 Concerning Station Blackout Complies With the Backfit Rule 10 CFR 50.109

The Commission's existing regulations establish requirements for the design and testing of onsite and offsite electrical power systems (10 CFR Part 50, Appendix A, General Design Criteria 17 and 18). However, as operating experience has accumulated, the concern has arisen regarding the reliability of both the offsite and onsite emergency ac power systems. These systems provide power for various safety systems, including reactor core decay heat removal and containment heat removal, which are essential for preserving the integrity of the reactor core and the containment building, respectively. In numerous instances emergency diesel generators have failed to start and run during tests conducted at operating plants. In addition, a number of operating plants have experienced a total loss of offsite electric power, and more such occurrences are expected. Existing regulations do not require explicitly that nuclear power plants be designed to withstand the loss of all ac power for any specified period.

This issue has been studied by the staff as part of Unresolved Safety Issue (USI) A-44, "Station Blackout." Both deterministic and probabilistic analyses were performed to determine the timing and consequences of various accident sequences and to identify the dominant factors affecting the likelihood of core

melt accidents from station blackout. Although operational experience shows
that the risk to public health and safety is not undue, these studies, which
have evaluated plant design features and site-dependent factors in detail, show
that blackout can be a significant contributor to the overall residual risk.
Consequently, the Commission is amending its regulations to require that plants
be capable of withstanding a total loss of ac power for a specified duration
and to maintain reactor core cooling during that period.

An analysis of the benefits and costs of implementing the station blackout rule
is presented NUREG-1109, "Regulatory/Backfit Analysis for the Resolution

227

-49-
[7590-01]

of Unresolved Safety Issue A-44, Station Blackout. The estimated benefit from
implementing the station blackout rule is a reduction in the frequency of core
damage per reactor-year due to station blackout and the associated risk of
offsite radioactive releases. The risk reduction for 100 operating reactors is
estimated to be 145.000 person-rem and supports the Commission's conclusion
that •50.63 provides a substantial improvement in the level of public health
and safety protection.

The cost for licensees to comply with the rule would vary depending on the
existing capability of each plant to cope with a station blackout, as well as
the specified station blackout duration for that plant. The costs would be
primarily for licensees (1) to assess the plant's capability to cope with a
station blackout, (2) to develop procedures, (3) to improve diesel generator
reliability if the reliability falls below certain levels, and (4) to

retrofit
plants with additional components or systems, as necessary, to meet th
e
requirements.

The estimated total cost for 100 operating reactors to comply with the
 resolu-
tion of USI A-44 is about $60 million. The average cost per reactor w
ould be
around $600,000, ranging from $350,000, if only a station blackout ass
essment
and procedures and training are necessary, to a maximum of about $4 mi
llion if
substantial modifications are needed, including requalification of a d
iesel
generator.

The overall value-impact ratio, not including accident avoidance costs
, is
about 2,400 person-rem averted per million dollars. If the net cost,
which
includes the cost savings from accident avoidance (i.e., cleanup and r
epair of
onsite damages and replacement power following an accident), were used
, the
overall value-impact ratio would improve significantly to about 6,100
person-
rem averted per million dollars. These values, which exceed the $1,00
0/person-
rem interim guidance provided by the Commission, support proceeding wi
th the
implementation of •50.63.

228

-50-
[7590-01]

The preceding quantitative value-impact analysis was one of the factor
s
considered in evaluating the rule, but other factors also played a par
t in the
decision-making process. Probabilistic risk assessment (PRA) studies
performed
for this USI, as well as some plant-specific PRAS, have shown that sta
tion
blackout can be a significant contributor to core melt frequency, and,
 with
consideration of containment failure, station blackout events can repr

esent an
important contributor to reactor risk. In general, active systems req uired for
containment heat removal are unavailable during station blackout. The refore,
the offsite risk is higher from a core melt resulting from a station b lackout
than it is from many other accident scenarios.

Although there are licensing requirements and guidance directed at pro viding
reliable offsite and onsite ac power, experience has shown that there are prac-
tical limitations in ensuring the reliability of offsite and onsite em ergency
ac power systems. Potential vulnerabilities to common cause failures associated with design, operational, and environmental factors can aff ect ac
power system reliability. For example, if potential common cause fail ures of
emergency diesel generators exist (e.g., in service-water or dc power support
systems), then the estimated core damage frequency from station blacko ut events
can increase significantly. Also, even though recent data indicate th at the
average emergency diesel generator reliability has improved slightly s ince
1976, these data also show that diesel generator failure rates during unplanned
demand (e.g., following a loss of offsite power) were higher than that during
surveillance tests.

The estimated frequency of core damage from station blackout events is directly
proportional to the frequency of the initiating event. Estimates of s tation
blackout frequencies for this USI were based on actual operational exp erience
with credit given for trends showing a reduction in the frequency of l osses of
offsite power resulting from plant-centered events. This is assumed t o be a
realistic indicator of future performance. An argument can be made th at the
future performance will be better than the past. For example, when pr oblems
with the offsite power grid arise, they are fixed and, therefore, grid reli-

229

-51-
[7590-01]

ability should improve. On the other hand, grid Power failures may be come more frequent because fewer Plants are being built, and more power is being trans-mitted among regions, thus placing greater stress on transmission line s.

The factors discussed above support the determination that additional defense-in-depth provided by the ability of a plant to cope with station black out for a specific duration would provide substantial increase in the overall pr otection of the public health and safety, and the direct and indirect costs of implemen-tation are justified in view of this increased protection. The Commis sion has considered how this backfit should be prioritized and scheduled in lig ht of other regulatory activities ongoing at operating nuclear power plants. Station blackout warrants a high priority ranking based on both its status as an "unresolved safety issue" and the results and conclusions reached in r esolving this issue. As noted in the implementation section of the rule (•50.6 3(c)(4)), the schedule for equipment modification (if needed to meet the require ments of the rule) shall be established by the NRC staff in consultation and coordination with the licensee. Modifications that cannot be schedule d for completion within two years after NRC accepts the licensee's specified station blackout duration must be justified by the licensee. The NRC retains the authority to determine the schedules for modifications.

In addition, some foreign countries, including France, Britain, Sweden , Germany and Belgium, have taken steps to reduce the risk from station blackout events. These steps include adding design features to enhance the capability o

f the
plant to cope with a station blackout for a substantial period of time and/or
adding redundant and diverse emergency ac power sources.

Analysis of 50.109(c) Factors

1. Statement of the specific objectives that the backfit is designed to
achieve

230

-52-
[7590-01]

The NRC staff has completed a review and evaluation of information developed since 1980 on Unresolved Safety Issue (USI) A-44, Station Blackout. As a result of these efforts, the NRC is amending 10 CFR Part 50 by adding a new • 50.63, "Station Blackout."

The objective of the station blackout rule is to reduce the risk of severe accidents associated with station blackout. Specifically, the rule requires all light-water-cooled nuclear power plants to be able to cope with a station blackout for a specified duration and to have procedures and training for such an event. A regulatory guide, to be issued along with the rule, provides an acceptable method to determine the station blackout duration for each plant. The duration is to be determined for each plant based on a comparison of the individual plant design with factors that have been identified as the main contributors to risk of core melt resulting from station blackout. These factors are (1) the redundancy of onsite emergency ac power sources, (2) the reliability of onsite emergency ac power sources, (3) the frequency of loss of offsite power, and (4) the probable time needed to restore offsite power.

2. General description of the activity required by the licensee or applicant
in order to complete the backfit

In order to comply with the resolution of USI A-44, licensees will be required to --

ø Maintain the reliability of onsite emergency ac power sources at or above specified acceptable reliability levels.

ø Develop procedures and training to restore ac power using nearby po wer
sources if the emergency ac power system and the normal offsite power sources are unavailable.

231

-53-
[7590-01]

ø Determine the duration that the plant should be able to withstand a
station blackout based on the factors specified in •50.63, "Station Blackout," and Regulatory Guide 1.155, "Station Blackout.

ø If available, an alternate ac power source that meets specific criteria for independence and capacity can be used to cope with a station blackout.

ø Evaluate the plant'S actual capability to withstand and recover fro m a
station blackout. This evaluation inc7udes:

- Verifying the adequacy of station battery power, condensate storage tank capacity, and plant/instrument air for the station blackout duration.

- Verifying the operability of equipment needed to operate during a station blackout and the recovery from the blackout for environmental conditions associated with total loss of ac power (i.e., loss of heating, ventilation, and air conditioning).

ø Depending on the plant's existing capability to cope with a station blackout, licensees may or may not need to backfit hardware modifications (e.g., adding battery capacity) to comply with the rule. (See item 8 of this analysis for additional discussion.) Licensees will be required to have procedures and training to cope with and recover from a station blackout.

3. Potential change in the risk to the public from the accidental off site
release of radioactive material

232

-54-
[7590-01]

Implementation of the station blackout rule will result in an estimated total risk reduction to the public ranging from 65,000 to 215,000 person-rem with a best estimate of about 145,000 person-rem.

4. Potential impact on radiological exposure of facility employees

For 100 operating reactors, the estimated total reduction in occupational exposure resulting from reduced core damage frequencies and associated postaccident cleanup and repair activities is 1,500 person-rem. No significant increase in occupational exposure is expected from operation and maintenance activities associated with the rule. Equipment additions and modifications contemplated do not require work in and around the reactor coolant system and therefore are not expected to result in significant radiation exposure.

5. Installation and continuing costs associated with the backfit, including the cost of facility downtime or the cost of construction delay

For 100 operating reactors, the total estimated cost associated with the station blackout rule ranges from $42 to $94 million with a best estimate of $60 million. This estimate breaks down as follows:

Activity	Estimated number of reactors	Estimated total cost (million dollars) Best	High	Low
Assess plant's capability to cope with station blackout	100	25	40	20
Develop procedures and training	100	10	15	5
Improve diesel generator reliability	10	2.5	4	1.5
Requalify diesel generator	2	5.5	11	2.5
Install hardware to increase plant capability to cope	27	17	24	13

with station blackout

Totals	60	94	42

233

-55-
[7590-01]

6. The potential safety impact of changes in plant or operational com plexity,
including the relationship to proposed and existing regulatory require ments

The rule requiring plants to be able to cope with a station blackout s hould
not add to plant or operational complexity . The station blackout rul e is
closely related to several NRC generic programs and proposed and exist ing
regulatory requirements as the following discussion indicates.

Generic Issue B-56, Diesel Generator Reliability

The resolution of USI A-44 includes a regulatory guide on station blac kout
that specifies the following guidance on diesel generator reliability (Regulatory Guide 1.155, Sections C1.1. and C.1.2):

The minimum emergency diesel generator (EDG) reliability should be targeted at 0.95 per demand for each EDG for plants in emergency ac Groups A, B, and C and at 0.975 per demand for each EDG for plants in emergency ac Group D (see Table 2). These reliability levels will be considered minimum target reliabilities and each plant should have an EDG reliability program containing the principal elements, or their equivalent, outlined in Requlatory Position 1.2. Plants that select a target EDG reliability of O' 975 will use the higher level as the target in their EDG reliability programs.

The reliable operation of onsite emergency ac power sources should be ensured by a reliabilit " y program designed to maintain and monito r
the reliability level of each power source over time for assurance that the selected reliability levels are being achieved. An EDG reliability program would typically be composed of the following elements or activities (or their equivalent):

1. Individual EDG reliability target levels consistent with the plant category and coping duration selected from Table 2.

2. Surveillance testing and reliability monitoring programs designed to track EDG performance and to support maintenance activities.

3. A maintenance program that ensures that the target EDG reliability is being achieved and that provides a capability for failure analysis and root-cause investigations.

4. An information and data collection system that services the elements of the reliability progam and that monitors achieved EDG reliability levels against target values.

234

-56-
[7590-01]

5. Identified responsibilities for the major program elements and a management oversight program for reviewing reliability levels being achieved and ensuring that the program is functioning Properly.

The resolution of B-56 will provide specific guidance for use by the staff or industry to review the adequacy of diesel generator reliability programs consistent with the resolution of USI A-44.

Generic Issue 23, Reactor Coolant Pump Seal Failures

Reactor coolant pump (RCP) seal integrity is necessary for maintaining primary system inventory during station blackout conditions. The estimates of core damage frequency for station blackout events for USI A-44 assumed that RCP seals would leak at a rate of 20 gallons per minute. Results of analyses performed for GI 23 will provide the information necessary to estimate RCP seal behavior during a station blackout. The industry coping analysis guidelines (NUMARC-8700) recognize the possibility of leakages exceeding an assumed 25 gpm per pump and incorporate the need to reevaluate the plant-specific coping analysis if the resolution of GI 23 identifies higher levels.

USI A-45, Shutdown Decay Heat Removal Requirements

The overall objective of USI A-45 is to evaluate the adequacy of current

licensing design requirements to ensure that the nuclear power plants do
not pose an unacceptable risk as a result of failure to remove shutdow n
decay heat. The study includes an assessment of alternative means of
shutdown decay heat removal and of diverse "dedicated" systems for thi s
purpose. Results will include proposed recommendations regarding the
desirability of, and possible design requirements for, improvements in
existing systems or an alternative dedicated decay heat removal method .

The USI A-44 concern for maintaining adequate core cooling under stati on
blackout conditions can be considered a subset of the overall A-45 iss ue.
However, there are significant differences in scope between these two

issues. USI A-44 deals with the probability of loss of ac power, the
capability to remove decay heat using systems that do not require ac
power, and the ability to restore ac power in a timely manner. USI A-
45
deals with the overall reliability of the decay heat removal function
in
terms of response to transients, small-break loss-of-coolant accidents
,
and special emergencies such as fires, floods, seismic events, and
sabotage.

Although the recommendations that might result from the resolution of
USI A-45 are not yet final, some could affect the station blackout cap
a-
bility, while others would not. Recommendations that involve a new or
improved decay heat removal system that is ac power dependent but that
does not include its own dedicated ac power supply would have no effec t on
USI A-44. Recommendations that involve an additional ac-independent d ecay
heat removal system would have a very modest effect on USI A-44.
Recommendations that involve an additional decay heat removal system w ith
its own ac power supply would have a significant effect on USI A-44.
Such

a new additional system would receive the appropriate credit within th
e
USI A-44 resolution by either changing the emergency ac power config-
uration group or providing the ability to cope with a station blackout
 for
an extended period of time. Well before plant modifications, if any,
will
be implemented to comply with the station blackout rule, it is anticip
ated
that the proposed technical resolution of USI A-45 will be published f
or
public comment. Those plants needing hardware modifications for stati
on
blackout could be reevaluated before any actual modifications are made
 so
that any contemplated design changes resulting from the resolution of
USI A-45 can be considered at the same time.

Generic Issue A-30, Adequacy of Safety-Related DC Power Supply

The analysis performed for USI A-44 assumed that a high level of dc po
wer
system reliability would be maintained so that (1) dc power system
failures would not be a significant contributor to losses of all ac po
wer
and (2) should a station blackout occur, the probability of immediate
dc

236

-58-
[7590-01]

power system failure would be low. Whereas Generic Issue A-30 focuses
 on
enhancing battery reliability, the resolution of USI A-44 is aimed at
ensuring adequate station battery capacity in the event of a station
blackout of a specified duration. Therefore, these two issues are
consistent and compatible.

Fire Protection Program

Section 50.48 of 10 CFR Part 50 states that each operating nuclear pow
er
plant must have a fire protection plan that satisfies GDC 3. The fire
protection features required to satisfy GDC 3 are specified in Appendi
x R
to 10 CFR Part 50. They include certain provisions regarding alternat

ive
and dedicated shutdown capability. To meet these provisions, some licensees have added, or plan to add, improved capability to restore p ower
from offsite sources or onsite diesels for the shutdown system. A few plants have installed a safe shutdown facility for fire protection tha t
includes a charging pump powered by its own independent ac power sourc e.
In the event of a station blackout, this system can provide makeup capability to the primary coolant system as well as reactor coolant pu mp
seal cooling. This could be a significant benefit in terms of enhanci ng
the ability of a plant to cope with a station blackout. Plants that h ave
added equipment to achieve alternate safe shutdown in order to meet Appendix R requirements could take credit for that equipment, if available, for coping with a station blackout event.

7. The estimated resource burden on the NRC associated with the backf it and
the availability of such resources

The estimated total cost for NRC review of industry submittals require d by
the station blackout rule is $1.5 million based on submittals for 100 reactors and an estimated average of 175 person-hours per reactor.

8. The potential impact of differences in facility type, design, or a ge on
the relevancy and practicality of the backfit

237

-59-
[7590-01]

The station blackout rule applies to all pressurized water reactors an d
boiling water reactors. However, in determining an acceptable station blackout coping capability for each plant, differences in plant charac -
teristics relating to ac power reliability (e.g., number of emergency diesel generators, the reliability of the offsite and onsite emergency ac
power systems) could result in different acceptable coping capabilitie s.

For example, plants with an already low risk from station blackout bec
ause
of multiple, highly reliable ac power sources are required to withstan
d a
station blackout for a relatively short period of time; and few, if an
y,
hardware backfits would be required as a result of the rule. Plants w
ith
currently higher risk from station blackout are required to withstand
somewhat longer duration blackouts; and, depending on their existing
capability, may need some modifications to achieve the longer station
blackout capability.

9. Whether the backfit is interim or final and, if interim, the justi
fication
for imposing the backfit on an interim basis

The station blackout rule is the final resolution of USI A-44;-it is n
ot
an interim measure.

238
REGULATORY GUIDE 1.155

STATION BLACKOUT
(TASK SI 501-4)

A. INTRODUCTION

Criterion 17, "Electric Power Systems," of Appendix A, "General Design
Criteria for Nuclear Power Plants," to 10 CFR Part 50, "Domestic Licen
sing of
Production and Utilization Facilities," includes a requirement that an
onsite
electric power system and an offsite electric power system be provided
to
permit functioning of structures, systems, and components important to
safety.

Criterion 1, "Quality Standards and Records," of Appendix A to 10 CFR
Part 50 includes a requirement for a quality assurance program to prov
ide
adequate assurance that structures, systems, and components important
to
safety will perform their safety functions.

Criterion 18, "Inspection and Testing of Electric Power Systems," of
Appendix A to 10 CFR Part 50 incudes a requirement for appropriate per
iodic

testing and inspection of electric power systems important to safety

The Commission has amended its regulations in 10 CFR Part 50. Paragraph (a), "Requirements," of • 50.63, "Loss of All Alternating Current Power," requires that each light-water-cooled nuclear power plant be able to withstand and recover from a station blackout (i.e., loss of the offsite electric power system concurrent with reactor trip and unavailability of the onsite emergency ac electric power system) of a specified duration. Section 50.63 requires that, for the station blackout duration, the plant be capable of maintaining core cooling and appropriate containment integrity. It also identifies the factors that must be considered in specifying the station blackout duration.

Criteria 1 and 18 of Appendix A to 10 CFR 50 apply to safety related grade equipment needed to cope with station blackout and other safety functions. Appendix A of this regulatory guide provides quality assurance guidance for non-safety systems and equipment used to meet the requirements of • 50.63.