Docket Nos. ~~50-155~~
50-255

SEP 07 1979

Mr. David Bixel
Nuclear Licensing Administrator
Consumers Power Company
212 West Michigan Avenue
Jackson, Michigan 49201

Dear Mr. Bixel:

SUBJECT: MINIMUM FIRE BRIGADE SHIFT SIZE

By letters dated November 25, 1977, June 8, 1978 and June 19, 1978, you were sent our position regarding the minimum size of the fire brigade for each operating shift at the Big Rock Point and Palisades Plant. Our position was that a minimum of five members, fully trained for fire fighting, is necessary. You responded by letters dated December 15, 1977, June 29, 1978 and September 15, 1978, and proposed a smaller brigade of three members and provided a justification therefor. After reviewing fire protection at your facilities and other operating facilities, we have concluded, based on the possible demands that may be placed on the brigade and the consequent actions that may be required of the brigade to fight fires, that five members constitute the minimum acceptable fire brigade size. Our generic evaluation is enclosed to this letter as Enclosure 1 and addresses the major points you raised to justify a smaller brigade size.

Our letter dated June 8, 1978, included a document entitled, "Manpower Requirements for Operating Reactors." That document provided the bases for allowing the sharing of duties to meet minimum staffing requirements for fire brigades at nuclear power plants. In performing our evaluations of the use of personnel who are not members of the operations staff, an issue was raised as to the amount of training to be given these personnel. We are, therefore, enclosing for your guidance our position on minimum fire brigade training (Enclosure 2) which modifies, for up to two members of the brigade, the previous guidance given in "Nuclear Plant Fire Protection Functional Responsibilities, Administrative Controls and Quality Assurance," June 14, 1977.

7910160237

Of the seventy plants presently licensed to operate all but eighteen have a requirement in their Technical Specifications for a minimum fire brigade shift size of five persons. Discussions held with licensees of those

CR
MAY

OFFICE ➔						
SURNAME ➔						
DATE ➔						

NRC FORM 318 (9-76) NRCM 0240 ★ U.S. GOVERNMENT PRINTING OFFICE: 1978 - 265 - 769

eighteen plants have resulted in a commitment by the licensee to propose such a Technical Specification except for six utilities who are the licensees for twelve plants. Because the staff believes that the fire brigade at each facility should consist of a minimum of five persons, we are preparing a proposed change to 10 CFR Part 50 which would incorporate this minimum fire brigade shift size into the Commission's regulations as a requirement for each operating license.

Until this is completed, we feel that it is prudent for you to have such a requirement in the Technical Specifications for your plants. We request that within 30 days of your receipt of this letter, you propose amendments to Facility Operating License No. DPR-6 and Provisional Operating License No. DPR-20 to change the minimum size of the fire brigade contained in the Technical Specifications for the Big Rock Point and Palisades Plants to five members. We intend to make this Technical Specification effective within 90 days of the issuance of the amendment.

Sincerely,

Original signed by
Darrell G. Eisenhut

Darrell G. Eisenhut, Acting Director
Division of Operating Reactors

Enclosures:
1. NRC Evaluation of Minimum Fire Brigade Shift Size
2. NRC Staff Position - Minimum Fire Brigade Training

cc w/enclosures:
See next page

DISTRIBUTION
Docket (50-155/255)
NRC PDR
Local PDR
ORB #2 Reading
NRR Reading
DLZiemann
HSmith
RDSilver
BGrimes
TJCarter
TVWambach
OELD
OI&E (3)
GLainas (5)
RFerguson
JRBuchanan
TERA
ACRS (16)
DCrutchfield

OFFICE	DOR:ORB #2	DOR:ORB #2	DOR:ORB #2	DOR:AD/SEP	DOR:ADDIR	
SURNAME	RDSilver:ah	TVWambach	DLZiemann	RHVollmer	DGEisenhut	
DATE	8/29/79	9/4/79	9/4/79	9/5/79	9/7/79	

NRC FORM 318 (9-76) NRCM 0240 ★ U.S. GOVERNMENT PRINTING OFFICE: 1978 - 265 - 769

SEP 07 1979

cc w/enclosures:
M. I. Miller, Esquire
Isham, Lincoln & Beale
Suite 4200
One First National Plaza
Chicago, Illinois 60670

Mr. Paul A. Perry, Secretary
Consumers Power Company
212 West Michigan Avenue
Jackson, Michigan 49201

Judd L. Bacon, Esquire
Consumers Power Company
212 West Michigan Avenue
Jackson, Michigan 49201

Myron M. Cherry, Esquire
Suite 4501
One IBM Plaza
Chicago, Illinois 60611

Kalamazoo Public Library
315 South Rose Street
Kalamazoo, Michigan 49006

Hunton & Williams
George C. Freeman, Jr., Esquire
P. O. Box 1535
Richmond, Virginia 23212

Peter W. Steketee, Esquire
505 Peoples Building
Grand Rapids, Michigan 49503

Charlevoix Public Library
107 Clinton Street
Charlevoix, Michigan 49720

Ms. Mary P. Sinclair
Great Lakes Energy Alliance
5711 Summerset Drive
Midland, Michigan 48640

ATTACHMENT 1

EVALUATION OF

MINIMUM FIRE BRIGADE SHIFT SIZE

JUNE 8, 1979

EVALUATION OF

MINIMUM FIRE BRIGADE SHIFT SIZE

Table of Contents

EVALUATION OF

MINIMUM FIRE BRIGADE SHIFT SIZE

I. INTRODUCTION

Criterion 3 of the General Design Criteria (GDC) for Nuclear Power Plants (Appendix A to 10 CFR 50) reads as follows:

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

The above mentioned fire fighting systems consist of both automatic and manual systems. The minimum fire brigade shift is an essential part of the manual fire fighting system (i.e., detectors, portable extinguishers, hose stations and fire brigade) which must function to "minimize the adverse effects of fires on structures, systems and components important to safety."

This evaluation summarizes the staff's and its consultant's evaluation of the factors that establish the minimum fire brigade shift size. We have concluded that all operating plant sites should have an onsite fire brigade shift of at least five members appropriately trained for fire fighting. The fire brigade shift should be capable of performing a spectrum of actions that may be necessary to cope with a variety of fire situations. One member should be assigned as fire brigade leader to assess the situation and direct fire fighting activities. Four members should be available to transport equipment to the fire, operate suppression equipment, or perform rescue work as required by the specific fire.

II. BACKGROUND

The need for and the role of the fire brigade as part of the fire protection program for operating plants has been under evaluation by the staff since the Brown's Ferry Fire in March 1975.

Following its study of the Brown's Ferry Fire, the Nuclear Regulatory Commission's Special Review Group Report, dated February 1976, stated the need for an adequate fire brigade:

"In addition to adequate equipment design, successful fire fighting requires testing and maintenance of the equipment and training and practice as teams under realistic conditions for the onsite and offsite personnel who must fight the fire. Onsite and offsite equipment should be compatible. Emergency plans should recognize the need for fire fighting concurrent with other activities. They should provide for division of available personnel into preassigned, trained teams responsible for the various activities needed with proper utilization of offsite fire-fighters." (NUREG-0050 p.6).

"While the Review Group believes that such basic training is a necessary element in effective preparation for fire fighting, such training alone does not assure smooth operation of fire fighting personnel during a fire. Emergency plans should recognize the need for fire fighting concurrent with other activities. There must be a clear understanding of the duties of the onsite personnel, with preassigned and trained teams for each needed function. The degree of dependency upon trained onsite fire fighting personnel must be related to the availability of support personnel from professional fire fighting units (city or county fire departments, military fire control units, etc.) or trained personnel in the licensee's organization who are available for such emergency service. In general, the onsite personnel should have sufficient training and practice to handle all small fires, and to contain larger fires until the offsite units arrive. When it is deemed prudent to call in the offsite units, their capabilities should be used to the greatest extent possible. Periodic drills, involving all onsite and offsite organizations which may be expected to respond to a fire, should be held to enable the groups to train as a team, permit the offsite personnel to become failar with the plant layout, and to permit evaluation of the effectiveness of communication among all those involved. These drills should include operations personnel, those specifically assigned to fire fighting, any offsite emergency control centers involved in the plan, and all those other organizations that would normally respond to such emergencies." (NUREG-0050 p.27).

At Brown's Ferry Nuclear Station, a five man site fire Brigade was established to fight fires in any of the three units on this site. To assure the presence of this fire brigade at all times, a requirement for such a fire brigade organization was incorporated into the Fire Protection Program for these units. Subsequently, in furtherance of the objective of GDC.3 the NRC reflected this need at all plants for an adequate fire brigade in all guidelines issued on fire protection (i.e., Branch Technical Position (BTP) 9.5-1, Appendix A to BTP 9.5-1 and Regulatory Guide (R.G. 1.120.)

These NRC guidelines gave criteria for determining the size of the fire brigade:

"The plant should be self-sufficient with respect to fire fighting activities and rely on public response only for supplemental or backup capability" (Appendix A p.7).
"Guidance is contained in the following publications:... National Fire Protection Association (NFPA) 27 - Private Fire Brigades" (Appendix A p.4).

Regarding the size of the fire brigade, NFPA 27 states: "The equipment that must be put into service at a fire will determine the number of men required for each operating unit or company into which the brigade is organized and the total number needed in the brigade. Each company should have a leader and each brigade should have a chief." (NFPA p.27-3, Vol. 12) (Note that the site fire brigade on each shift corresponds to the company of NFPA 27; the organization of all shift fire brigades corresponds to the brigade of NFPA 27.)

In November 1977, the NRC issued additional guidance indicating that the fire brigade size should be determined by the functions the fire brigade must perform after consideration of several factors: (1) plant geometry and size; (2) quantity and quality of detection and suppression systems; (3) fire fighting strategies for postulated fires; (4) fire brigade training; (5) fire brigade equipment; and (6) fire brigade supplements by plant personnel and local fire departments. At that time, the staff established an interim fire brigade size of five persons until a site specific review could be completed.

In November 1977, the NRC sent licensees of operating facilities proposed interim Technical Specifications for fire protection which included the requirement for a five man fire brigade. The NRC position on Minimum Fire Brigade Shift Size was included with the Safety Evaluation supporting this requirement. The licensees' response on the requirement for a five man fire brigade was divided. Of 70 operating facilities, 51 accepted a five man brigade and 19 presented arguments for a smaller fire brigade shift size. To effect expeditious implementation of interim Technical Specifications requirements for fire protection, license amendments were issued which added Fire Protection Technical Specifications requiring the minimum fire brigade shift size as proposed by the licensees. Where the licensee proposed a fire brigade of fewer than five persons, the amendments contained the condition that the staff's evaluation of the licensee's basis for the smaller fire brigade size would be included in the site specific review of the licensee's fire protection program.

In April 1978, the NRC issued additional guidance regarding the sharing of personnel required onsite for the purpose of plant operation, industrial security and fire fighting. These guidelines recognized that: (1) the plant requires a minimum number of personnel to be on the site to cope with either an operating, security or fire emergency; (2) the probability of an event which requires entire minimum shift of each discipline during the first 30 minutes of the event is low; and (3) the shift supervisor should be able to use available site personnel

as the specific emergency demands.

Since October 22, 1976, the NRC fire protection review teams have visited all operating facilities. At each site, the staff evaluated the factors identified in its November 1977 guidance.*

III. DISCUSSION

We found that variations in plant geometry and size were not a determining factor for minimum fire brigade shift size because at all of the plants we found combinations of hazards, conditions of access, and physical arrangement of safety related equipment that would require immediate actions by at least five persons. In all but a few plants, the detection and suppression systems and fire brigade strategies, training, equipment, and supplementation by off-shift personnel are about equal because they met or committed to meet staff guidelines. In some cases, our site evaluation concluded that more than five persons were required for each shift; however, in these cases, prompt modifications were made by licensees to reduce the need for the additional manpower. None of the plants had support from local fire departments which was adequate to reduce the size of the fire brigade below five persons. All of the plants had sufficient support from local fire department and off shift personnel such that the minimum fire brigade shift size need not be increased above five. We also found that the major factors in determining the shift size of the fire brigade were (1) the need for leadership of the brigade by a person who is relatively free of other duties, including actively fighting the fire; (2) the equipment to be obtained and used for fighting the fire; and (3) the actions to be performed by the fire brigade for a variety of fire situations.

A. Defense-In-Depth

The concept of "defense-in-depth" which has been utilized throughout the site specific evaluations contains three major areas of protection, i.e., prevention, detection and suppression. First, administrative controls are required to limit the quantity of combustible and potential ignition sources. Second, detection systems are required to inform the plant staff in the event of a fire. Third, suppression systems, automatic and manual, are required to extinguish the fire rapidly and successfully. Functions pertaining to each of these areas requires a minimum level of performance to be accepted, e.g., the fire brigade must have a minimum acceptable size to be given credit for being able to perform its function under a broad spectrum of conditions.

The fire brigade is but one element of the"defense-in-depth" fire protection program which contributes to the adequacy of the fire protection that assures that the public health and safety is not endangered due to potential consequences of fire at an operating facility. To consider this issue in perspective, it is necessary to remember that if a severe fire occurs, the plant conditions which lead to or result from the fire cannot be

---

*Some of the licensees' arguments for a smaller shift size are discussed in Appendix A.

precisely defined and that no single echelon of fire protection can be perfect or complete in itself.

The demands on the manual fire fighting capability and resources will vary depending on their degree of involvement:

1. If the automatic detection and suppression system functions as designed, the combustibles involved in the fire are limited to those evaluated in the design, and all other conditions for the fire are the same as for the design evaluation, the fire will probably be controlled and possibly extinguished by the installed system. The fire brigade will be needed to enter the involved area to conduct final "mop-up" actions and inspection to ensure the fire is completely extinguished.

2. If the fire is of a larger magnitude than the design assumption of the automatic systems or the fire spreads beyond the coverage of the automatic system because of the deterioration of design conditions, the fire brigade will be required to assist in the extinguishment operation and possibly in the protection of adjacent safety related equipment which may be jeopardized by the fire.

3. If the automatic systems do not actuate, the fire brigade will be required to independently contain and extinguish the fire in the involved zone. Similar action is required in all areas that do not have automatic suppression systems.

When determining the minimum fire brigade size, each of the above three levels of performance must be considered and evaluated, with the third level bounding the brigade size since it places the largest burden on the team.

Further, the specific fire brigade actions that will be required will vary from area to area within the plant, and with the construction, maintenance or normal operation activities that may be ongoing at the time of the fire. Because the specific fire brigade actions cannot be precisely defined, the fire brigade must be capable of a spectrum of actions that may be required. The minimum fire brigade and the available manual equipment is the only fire suppression system in many areas of the plant. Thus, the brigade and their equipment must satisfy the requirements of the General Design Criteria to minimize the adverse effects of fire on systems important to safety for these areas as well as provide its contribution to the defense-in-depth features in other areas which also have automatic suppression systems. The fire brigade offers the flexibility to perform actions to mitigate the consequences of fires for the event that may exceed the limits of fixed fire protection systems and, with early warning fire detection, to extinguish fires before automatic systems actuate.

Even though the fire brigade is only one aspect of the "defense-in-depth", it requires a minimum operating size to successfully fulfill its performance objectives as defined in the following section of this document. To reduce the size below the needed level will result in the loss of brigade flexibility and the potential that all performance objectives will not be achieved.

B. Fire Brigade Performance Objectives

The performance objectives of the fire brigade at a nuclear power plant are the same as those in any fire situation. There are three major performance objectives: (1) rescue; (2) extinguish; and (3) confine, control and extinguish. Which of these objectives are to be performed depends upon the specific factors that are present at the fire; however, the order of performance of these objectives never changes. Where there is no need for rescue, the first objective can be "extinguish". In all cases, even the most extreme, the final objective always is to extinguish the fire. This is true even where it is first necessary to confine the fire, then bring it under control and finally extinguish it. In extremely rare and unusual circumstances, a fire may be allowed to burn itself out as a last resort. We have not endorsed this alternative as the design condition because of the potential deleterious effects on plant operation associated with the toxic and corrosive effects of the smoke and additional system failures that may occur.

To achieve any one, or all of the major objectives, the fire brigade must perform several functions. Some of these are:

(a) Locate the fire and ascertain its potential;

(b) Localize the fire, alleviate smoke and heat conditions, improve visibility, and facilitate the advance of hose lines;

(c) Extinguish the fire by application of a sufficient amount of the correct extinguishing medium;

(d) Minimize damage by the judicious use of water or other extinguishing agent;

*(e) Protect personnel, provide ventilation, self-contained breathing equipment and protective backup capability;

*(f) Coordinate activities through adequate supervision and communication.

To ascertain the potential of each specific fire, and to determine the required functions, there are certain primary factors that must be evaluated by the fire brigade leader at that time. Some of these primary factors are: life hazard for occupants and for personnel, location of fire, extent of fire on arrival, shutdown equipment and fixed suppression systems in the fire building, construction of fire building, construction of exposures, area of exposures, proximity of exposures, structural collapse of fire building, heat conditions, smoke conditions, visibility, exposure hazard, and class of fire.

---

*These are objectives from the beginning to the end of every fire suppression operation.

Some of these factors interact and the combination of effects of such factors also require the consideration of the fire brigade leader.

C. Fire Brigade Actions

The actions required of the fire brigade to achieve the performance objectives depend largely on the complexity of the fire; however, the shift fire brigade should be capable of performing a spectrum of actions for any fire.

If a fire alarm sounds for any area of the plant the following actions should be taken by the fire brigade:

(a) The fire brigade leader and all brigade members should immediately respond to the fire area.

(b) The brigade leader should respond directly to the fire area, with an extinguisher that he obtains on the way, and with adequate equipment for communications and a portable handlight.

(c) The other brigade members should respond to the fire area with a personal self-contained breathing apparatus and a portable extinguisher.

If on arrival at the fire area, an incipient fire is in progress, the following actions should be taken by the fire brigade:

(a) An immediate attack should be made on the fire in an attempt to extinguish.

(b) Additional extinguishers should be obtained from the immediate area.

(c) A hose line should be stretched to the fire area as a precaution.

(d) Additional self-contained breathing apparatus and spare cylinders should be obtained immediately to be ready for use if necessary.

If the fire is not extinguished in its incipient stage, the following actions may be required:

(a) Place the necessary calls for off-site assistance.

(b) If ladders are required to reach the fire, fire ladders should be obtained.

(c) If the fire involves electrical equipment, the equipment should be de-energized. This action requires coordination with operating personnel to assure it will not affect the continued safe operation of the plant.

(d) If smoke conditions are such that visibility is impaired, ventilation may be required either in the form of activation of fixed systems or by the use of portable smoke ejectors.

(e) If it becomes necessary to use water fog, precautions should be taken to prevent water damage to electrical equipment not involved in the fire. This may require the use of protective water shielding.

(f) If it becomes necessary to use water fog, a second hose line, from a standpipe or exterior hose station should be prepared to serve as a back up to the initial hose line.

(g) If the fire area is one that contains a special hazard such as a flammable or combustible liquids, some of the brigade members should obtain and prepare the special equipment necessary for that type of operation; i.e., foam in 5 gallon cans, pick up tube, foam applicator and hose lines.

(h) If the fire is in a confined space and its exact location cannot readily be determined, the fire brigade leader may commit all his personnel to the attempt to locate the fire, but should do so only after all other required preparatory actions have been carried out.

(i) If any of the brigade members, who are actively extinguishing the fire or attempting to locate the fire, become trapped or incapacitated in anyway, other brigade members would be required to rescue. If the injury were such that the injured party were overcome by smoke or severely injured, at least one of the other members would be required to attend the injured to attempt to safe his life.

(j) If the fire has not been extinguished when offsite assistance arrives at the fire location, the offsite people should be divided into teams to assist the fire fighting operation with each team having a member of the plant brigade assigned as leader.

For any given area or fire, the initial actions of the brigade require sufficient personnel to extinguish the incipient fire and to prepare for the fire that may occur if the incipient fire is not extinguished. Therefore, the brigade should be adequately staffed so that the above actions can be performed if required by a particular fire.

Table 1 indicates how these required actions would be carried out by a five member fire brigade. Not all actions assigned to each member will necessarily be carried out for every fire; however, for the spectrum of fires that may reasonably be expected to occur; the brigade should be capable of performing the actions as shown. The five member fire brigade is the minimum complement that can provide sufficient personnel so that these actions may be carried out.

D. Typical Response to a Postulated Fire in a Nuclear Plant

The following outline describes how a brigade would respond to a postulated fire and carry out the actions discussed in the previous sections. The outline illustrates the need for some actions simultaneously and some sequentially. It also illustrates that the specific circumstances that determines the course of the fire will determine the specific actions required. The actions being performed by the fire brigade leader and the fire brigade members are summarized in Table 1.

1. The fire brigade leader and all brigade members should initiate their response to the announced fire area.

2. The fire brigade leader should respond directly to the announced fire area with portable communication equipment. He evaluates the situation, and advises the control room and formulates an action plan.

3. Each member of the fire brigade including the fire brigade leader obtains a fire extinguisher from a location along the way and bring it to the fire area. These should be brought from a remote location to assure that sufficient extinguishers will be available. Those in the immediate fire area may have been used by the discoverer of the fire.

4. Each member of the fire brigade should also bring a self-contained breathing apparatus for use by the brigade members.

5. If conditions are such that self-contained breathing apparatus masks will have to be worn by the brigade members, no member should enter the fire area without a mask. If necessary one or more, depending on the need, brigade members should be sent to obtain additional self-contained breathing apparatus in sufficient number so that each brigade member and the fire brigade leader will have a unit.

   At least one man should be sent to obtain spare air cylinders, at least one per self-contained breathing apparatus being used. (NOTE: Recent tests at Syracuse Fire Dept. Training Academy showed that the 1/2 hour rated mask, pressure demand type, was breathed down in as little as 7 to 15 minutes during fire fighting activities).

6. If the brigade members will pass by the personnel protective clothing storage area, they should obtain their fire fighting gear and bring it to the fire scene. If such clothing is needed but is not brought to the scene, at least one man should be sent to obtain such clothing.

7. If the source of the fire or smoke can be readily determined, the brigade leader should order the following simultaneous actions:

   (a) At least two (2) man to begin a direct attack on the fire with suitable extinguishers and,

   (b) the remaining two (2) men to prepare to assist with additional extinguishers and/or to stretch at least one 1-1/2" standpipe hose line to be used as a back up to the extinguishers.

   If the fire is readily extinguished by the initial extinguisher application, the brigade leader should make a careful examination of the fire area to insure that the fire has been completely extinguished and to try to determine the point of origin and the cause of the fire. He would be assisted by at least one brigade member. Consideration should be given for the need for a fire watch in the area for a period of up to 24 hours.

   The remaining brigade members would be directed to return the fire fighting equipment brought to the fire location to its proper storage area ensuring that it is in proper working order and in readiness for another fire.

   A critique of the fire fighting operation should be held immediately after the fire to evaluate the pre-fire strategies for the fire area and to determine the efficiency of the fire brigade and the effectiveness of the operation.

8. If the smoke conditions are such that the location of the source of the fire and smoke cannot readily be determined, the brigade leader should order the following simultaneous actions:

   (a) The control room to notify the off-site fire department and plant on-call personnel.

   (b) Two brigade members and the leader to put on self-contained breathing apparatus, take suitable extinguishers and enter the fire area to attempt to locate the fire.

   (c) The remaining brigade members to put on self-contained breathing apparatus and stretch a 1-1/2" hose line from the closest standpipe location and assure that the hose has sufficient length to effectively reach the fire area.

   (d) After the hose line is stretched and ready to be operated, at least one member should remain with the line while the other(s) go to obtain additional equipment usch as smoke ejectors, ladders if necessary, spare air cylinders, protective covers for water sensitive equipment, and any other items that would be of need in the fire and damage control effort.

   (e) If while the above activity is going on- the fire source is located by the leader and the two brigade members, they would immediately attempt to extinguish the fire with their extinguishers. (If successful, the steps subsequent to extinguishment outlined in 7 above would be followed).

9. If the fire is not readily extinguished by the use of extinguishers, the following actions should be undertaken by the fire brigade as ordered by the fire brigade leader.

   (a) The 1-1/2" hose line that has been stretched as a precauthionary measure should be advanced into the fire area by at least two brigade members and;

   (b) The remaining brigade members should simultaneously stretch an additional 1-1/2" hose line from the closest available standpipe location to the area immediately outside or adjacent to the fire area and be prepared to use this line to provide protective spray and/or as a backup attack line if the fire severity demands. (NOTE: It is likely that the second 1-1/2" hose line will have to have additional hose added to reach the fire area).

   (c) Once the second line is readied for use and if its immediate use is not required, the fire brigade leader may direct one or more of the back up men to take steps to provide protection for electrical equipment or to set up portable ventilation equipment to evacuate smoke and heat, or to obtain additional special equipment that may be required if the fire is not controlled and extinguished in a short time.

   (d) If the brigade leader and the men attacking the fire with the 1-1/2" hose line are successful in extinguishing the fire, the steps subsequent to extinguishment contained in 7 above should be followed.

10. If the fire is not extinguished by the attack with 1-1/2" hose lines, the area may become untenable as a result of either heat or smoke or both. In this situation the fire brigade leader should order the following actions by the fire brigade.

   (a) All personnel should back out of the fire area and take positions where they can either keep the fire contained by the use of the hose lines from the perimeter openings or

   (b) The area should be sealed off, if possible, by closing the fire doors and the hose lines should be used by brigade members to attempt to keep the fire from passing through any penetrations or ducts or fire doors or the exterior walls by spraying water on the potentially dangerous areas to keep it cooled down.

   (c) If the situation develops to this extent in a relatively short time period (less than 15-20 minutes) it may be necessary for the brigade leader to direct that one individual hold the 1-1/2" hose line from a suitable braced position while the other members are sent for additional back up hose lines, additional air supply, and to check surrounding areas and floors above the fire for possible extension of the fire.

(d) The fire fighting objective would now become a matter of confine, control and extinguish (or allow to burn out). When this occurs there will be a very serious problem of smoke and heat removal which will require the efforts of all available personnel as they arrive from off-site.

(e) Decisions will have to be made regarding the direction the smoke and heat is to be routed with serious consideration given to the possible damage the smoke and/or heat might cause to equipment that is relatively remote from the fire.

IV. CONCLUSION

On the basis of its onsite evaluations of the fire protection program for 70 operating facilities, the NRC staff has found that:

1. The specific actions for the control and extinguishment of potential fires vary greatly from area to area within a given plant;

2. The specific actions which the fire brigade may be required cannot be precisely defined prior to the fire;

3. Although the fire fighting actions as described previously in this report may not be applicable to each and every plant area, all plants contain areas important to plant safety which require consideration of these fire fighting actions.

4. Abnormal events cannot be precluded for each and every potential fire situation, some margin in brigade size is warranted to compensate for the potential unanticipated events such as:

   a. Failure of detection systems to promptly alert plant personnel of the onset of a fire condition.

   b. Failure of automatic suppression systems to actuate to limit fire damage.

   c. Personnel injury in the act of fire fighting.

   d. Failure of administrative controls of combustible materials in situations which could impact systems important to safety.

5. The minimum fire brigade shift size cannot be based only upon the potential fire consequences and their apparent impact on the capability to safely shutdown because this is contradictory to both the philosophy of defense-in-depth and the general design criterion requirement to minimize the adverse effects of fires.

Based on the above, we conclude that:

1. All operating plant sites should have an onsite fire briagde shift complement of at least five trained persons.

2. One member should be assigned as fire brigade leader and at the time of the fire, he should be free of all duties so that he can devote his attention to assessment of the fire situation and direction of fire fighting activities.

3. Four members should be capable of acting individually or as teams to perform the spectrum of basic fire fighting action which may be required e.g., locating the fire, operation of portable extinguisher or hose lines, transporting equipment to the fire scene, or rescue work.

TABLE 1

MANPOWER REQUIRED FOR
FIRE FIGHTING ACTIONS

LEADER	FIRST & SECOND BRIGADE MEMBERS	THIRD & FOURTH BRIGADE MEMBERS
A. ACTIONS REQUIRED FOR FIRE NOT EXTINGUISHED BY PERSON(s) WHO DISCOVERED FIRE.		
Respond to fire with portable fire extinguisher	Respond to fire with portable fire extinguishers.	Respond to fire with portable fire extinguishers.
Respond to fire with self-contained breating apparatus.	Respond to fire with self-contained breathing apparatus.	Respond to fire with self-contained breathing apparatus.
Locate fire or source of smoke	Locate fire or source of smoke.	Locate fire or source of smoke.
Evaluate the fire situation and the area involved to determine the effective actions to be taken and maintain communication with control room. (Required for all fires.	Operate fire extinguishers on the fire (if fire location is determined).	Operate fire extinguishers on the fire (if fire location is determined).
Direct fire fighting activities by the fire brigade members.		Stretch at least one 1-1/2" hose line to be used as backup to extinguishers.

TABLE 1 (cont.)

B. ADDITIONAL ACTIONS REQUIRED FOR FIRE NOT EXTINGUISHED WITH PORTABLE EXTINGUISHERS

At the scene of the fire, continuously evaluate the fire condition as it develops. Direct the activities of the other members and observe the fire fighting operation and judge its effectiveness and safety. Consider alternative actions that may be required as a result of changing conditions. Consider the consequences of actions being taken in regard to their impact on the overall safe shutdown capability of the plant.

The fire team leader should not become involved in the actual fire fighting process to the extent that he is unable to carry out the responsibilities of continuous evaluation and decision making.

Communicate with control room regarding fire status, equipment that may become disabled, need for off-site assistance, etc.

Extend and prepare to operate a 1-1/2" hose line or a single 2-1/2" hose line from an exterior hose house.

Attempt fire extinguishment as a two person team using one fire hose.

Obtain fire fighting protective clothing for fire brigade members. (If not brought on 1st response).

Obtain special equipment for fire fighting operations - ladder, foam, ventilation, breathing air.

Take steps to cover electrical equipment to prevent water damage.

When necessary, extend and prepare to operate a 1-1/2" hose line or a single 2-1/2" hose line from an exterior hose house.

Perform relief and rescue duties as required.

TABLE 1 (cont.)

C. ADDITIONAL ACTIONS REQUIRED FOR FIRE THAT DEMANDS ASSISTANCE BY OFF-SITE PERSONNEL

All actions required in B:

Be prepared to provide rescue of endangered personnel or fire brigade members if necessary.	Be prepared to provide rescue of endangered personnel or fire brigade members if necessary.	Be prepared to provide rescue of endangered personnel or fire brigade members if necessary.
Provide off-site fire fighting with sufficient information so they understand the situation as it exists on their arrival, the objective of the operation, the actions being taken to achieve the objective, advice and supervision of their actions in coordination with the fire brigade.	Serve as guide, coordinator and control person for off-site fire department.	Serve as guide, coordinator and control person for off-site fire department.
	Isolate and confine fire.	Isolate and confine fire.
	Use hoses to cool and protect barriers.	Use hoses to cool and protect barriers.
	Survey barriers for possible break through and extention of fire	Survey barriers for possible break through and extention of fire.

FOOTNOTES: Operations in fire areas should always be a team effort of at least two members for the purpose of improved operation and personal safety. If these two members are not fully trained fire brigade members, they would be replaced by the off-shift personnel when they arrive.

APPENDIX A

STAFF RESPONSE TO SELECTED LICENSEE'S ARGUMENTS

1. Historical Fires

Some licensees argue that the majority of historical fires in nuclear power plants were either self-extinguished or were extinguished by a small response force. Further, a large number of these fires occurred during the construction phase of the plants.

The NRC does not deem the size of historical fires a significant factor in determining the size of the minimum fire brigade. The small fires that self-extinguish or the fires that are easily extinguished present little, if any, threat to public health and safety.

Further, the circumstances that lead to fires in the construction phase are not precluded after the plant goes into operation. New construction at the site, major plant modifications and maintenance activities produce similar circumstances at an operating plant.

It is the fires that do not self-extinguish because of "off-design" conditions or are not promptly extinguished at operating plant sites which may present a threat to the plants capability to achieve and maintain safe shutdown conditions. For example, a temporary breakdown in the administrative controls over the use of combustibles and ignition source, a failure to detect a fire early, or adverse unanticipated events which either delay prompt extinguishment or lead to rapid fire development may lead toward the development of a severe fire.

Because of the possibility of these fires, the staff deems it prudent to maintain a site fire brigade which can promptly extinguish such fires in safety related areas with sufficient margin in size to account for adverse conditions and events.

2. Offsite Assistance

Some licensees argue that the minimum fire brigade may be less than five persons because of substantial offsite assistance.

The NRC concludes that the delay in prompt fire extinguishment incurred by reliance upon support from offsite fire departments or the call back of plant personnel does not provide an acceptable alternative to meeting the minimum manpower requirements for an onsite fire brigade.

Offsite fire departments could be committed to fighting fire elsewhere when a call goes out for their assistance. In many areas weather conditions could delay the response of offsite fire departments as well as operating personnel called back for additional assistance. While the NRC recognizes the importance of a preplanned utilization of offsite fire departments and call back personnel, such assistance does not justify a reduction of an adequate onsite fire brigade to provide an immediate initial attack on a fire.

3. Availability of Onsite Personnel

Some licensees argue that the potential for fire is greater during times when there is more than the minimum complement of plant operating personnel on onsite. In general, this is the period from about 8 to 5 on normal work days. It is during these periods during which normal maintenance operations are performed.

While the NRC recognizes the greater potential for fire during such time, this does not alleviate the need for an adequate fire brigade on the other shifts. It appears that there are sufficient personnel on site on all shifts to provide a five man fire brigade.

In its position paper on "Manpower Requirements for Operating Reactors" the NRC addressed the sharing of available onsite personnel such as the security forces as a means of meeting the manpower requirements for a five man fire brigade. The issue is not the availability of onsite personnel who could be utilized to combat fires; but rather the effective utilization of manpower resources to establish a trained team that responds to a fire and effectively performs those action which are essential to fire fighting.

ATTACHMENT 2

STAFF POSITION

MINIMUM FIRE BRIGADE TRAINING

CONCERN

During our evaluation of the training given to fire brigade members, the issue of whether all members of a five man fire brigade need be given identical training has been considered. In several instances licensees have proposed two levels of training for fire brigade members. These evaluations have established the minimum acceptable level of training.

STAFF POSITION

We prefer that all fire brigade members receive training in accordance with the staff guidelines set forth in "Nuclear Plant Fire Protection Functional Responsibilities, Administrative Controls and Quality Assurance," June 14, 1977:

Attachment 1. Fire Protection Organization
Attachment 2. Fire Brigade Training
Attachment 5. Fire Fighting Procedures
(Note: Copies of these attachments are enclosed)

Where the five man fire brigade has two levels of training, at least three members shall have training which fully conforms to the staff guidelines; however, two members may be excepted from the training requirements listed below:

1. Attachment 2:

1.0a (6) The direction and coordination of the fire fighting activities.

1.0a (9) Detailed review of fire fighting procedures and procedure changes.*

1.0a (10) Review of latest plant modifications and changes in fire fighting plans.

The excepted personnel should have general training in these subjects.

---

*The only portion of this item excepted is that associated with the fire fighting strategies which have been developed to conform with attachment 5, item d. "The strategies established for fighting fires in all safety-related areas and areas presenting a hazard to safety-related equipment."

Excerpts from:

"Nuclear Plant Fire Protection Functional Responsibilities, Administrative Controls, and Quality Assurance" (June 14, 1977).

Attachment 1. Fire Protection Organization
Attachment 2. Fire Brigade Training
Attachment 5. Fire Fighting Procedures

Attachment No. 1

FIRE PROTECTION ORGANIZATION

1.0 The organizational responsibilities and lines of communication pertaining to fire protection should be defined between the various positions through the use of organizational charts and functional descriptions of each position's responsibilities. As a minimum the positions/organizations responsible for the following should be designated:

a. The upper level offsite management position which has management responsibility for the formulation, implementation, and assessment of the effectiveness of the nuclear plant fire protection program.

b. The offsite management position(s) directly responsible for

(1) formulating, implementing, and periodically assessing the effectiveness of the fire protection program for the licensee's nuclear power plant including fire drills and training conducted by the fire brigade and plant personnel. The results of these assessments should be reported to the upper level management position responsible for fire protection with recommendations for improvements or corrective actions as deemed necessary.

(2) Using the following NFPA Publications for guidance to develop the fire protection program:

No. 4 - "Organization for Fire Services"
No. 4A - "Organization of a Fire Department"
No. 6 - "Industrial Fire Loss Prevention"
No. 7 - "Management of Fire Emergencies"
No. 8 - "Management Responsibilities for Effects of Fire on Operations"
No. 27 - "Private Fire Brigades"

c. The onsite management position responsible for the overall administration of the plant operations and emergency plans which include the fire protection and prevention program and which provides a single point of control and contact for all contingencies.

d. The onsite position(s) which:

(1) implements periodic inspections to: minimize the amount of combustibles in safety related areas; determine the effectiveness of housekeeping practices; assure the availability and acceptable condition of all fire protection systems/equipment, emergency breathing apparatus, emergency lighting, communication equipment, fire stops, penetration seals and fire retardant coatings; and assures prompt and effective corrective actions are taken to correct conditions adverse to fire protection and preclude their recurrence.

(2) is responsible for the fire fighting training for operating plant personnel and the plant's fire brigade; design and selection of equipment; periodic inspection and testing of fire protection systems and equipment in accordance with established procedures and evaluate test results and determine the acceptability of the systems under test.

(3) assists in the critique of all fire drills to determine how well the training objectives have been met.

(4) reviews and evaluates proposed work activities to identify potential transient fire loads.

(5) implements a program for indoctrination of all plant contractor personnel in appropriate administrative procedures which implement the fire protection program, and the emergency procedures relative to fire protection.

(6) implements a program for instruction of personnel on the proper handling of accidental events such as leaks or spills of flammable materials that are related to fire protection.

e. The onsite position responsible for fire protection quality assurance.

This position should be responsible for assuring the effective implementation of the fire protection program by planned inspections and scheduled audits. He should assure and verify that results of these inspections or audits are promptly reported to cognizant management personnel.

f. The positions which are part of the plant fire brigade

(1) The plant fire brigade positions should be responsible for fighting fires. The authority and responsibility of each fire brigade position relative to fire protection should be clearly defined.

(2) The responsibilities of each fire brigade position should correspond with the actions required by the fire fighting procedures.

(3) The responsibilities of the fire brigade members under normal plant conditions, should not conflict with their responsibilities during a fire emergency.

(4) The minimum number of trained fire brigade members available onsite for each operating shift should be consistent with the activities required to combat the most significant fire. The size of the fire brigade should be based upon the functions required to fight fires with adequate allowance for injuries.

(5) The recommendations for organization, training, and equipment of "PRIVATE FIRE BRIGADES" as specified in NFPA No. 27-1975, including the applicable NFPA publications listed in the Appendix to NFPA No. 27, are considered appropriate criteria for organizing, training, and operating a plant fire brigade.

2.0 Qualifications

a. The position responsible for formulation and implementation of the Fire Protection Program should have, within his organization, or as a consultant, a Fire Protection Engineer is a graduate of an engineering curriculum of accepted standing and shall have completed not less than six years of engineering attainment indicative of growth in engineering competency and achievement, three of which shall have been in responsible charge of fire protection engineering work. These requirements are the eligibility requirements as a Member in the Society of Fire Protection Engineers.

b. The fire brigade members qualifications should include satisfactory completion of a physical examination for performing strenuous activity, and of the fire brigade taining described in Attachment No. 2.

c. The personnel responsible for the maintenance and testing of the Fire Protection Systems should be qualified by training and experience for such work.

d. The personnel responsible for the training of the fire brigade should be qualified by training and experience for such work.

Attachment No. 2

FIRE BRIGADE TRAINING

The training program should assure that the capability to fight potential fires is established and maintained. The program should consist of an initial classroom instruction program followed by periodic classroom instruction, practice in fire fighting and fire drills:

1.0 Classroom Instruction

a. The initial classroom instruction should include:

(1) Identification of the fire hazards and associated types of fires that could occur in the plant, and an identification of the location of such hazards.

(2) Identification of the location of fire fighting equipment for each fire area, and familiarization with layout of the plant including access and egress routes to each area.

(3) The proper use of available fire fighting equipment, and the correct method of fighting each type of fire. The types of fires covered should include electrical fires, fires in cables and cable trays, hydrogen fires, flammable liquid, waste/debris fires, and record file fires.

(4) Indoctrination of the plant fire fighting plan with specific coverage of each individual's responsibilities.

(5) The proper use of communication, lighting, ventilation and emergency breathing equipment.

(6) The direction and coordination of the fire fighting activities (fire brigade leaders only).

(7) The toxic characteristics of expected products of combustion.

(8) The proper method for fighting fires inside buildings and tunnels.

(9) Detailed review of fire fighting procedures and procedure changes.

(10) Review of latest plant modifications and changes in fire fighting plans.

b. The instruction should be provided by qualified individuals knowledgeable, experienced, and suitably trained in fighting the types of fires that could occur in the plant and in using the types of equipment available in the nuclear power plant.

Members of the "Fire Protection Staff" and Fire Brigade Leaders may conduct this training.

c. Instruction should be provided to all fire brigade members and fire brigade leaders.

d. Regular planned meetings held every 3 months should repeat the classroom instruction program over a two year period.

2.0 Practice

Practice sessions should be held for fire brigade members on the proper method of fighting various types of fires of similar magnitude, complexity, and difficulty as those which could occur in a nuclear power plant. These sessions should provide brigade members with experience in actual fire extinguishment and the use of emergency breathing apparatus under strenuous conditions. These practice sessions should be provided at regular intervals but not to exceed 1 year for each fire brigade member.

3.0 Drills

Fire brigade drills should be performed in the plant so that the fire brigade can practice as a team. Drills should include the following:

a. Assessment of fire alarm effectiveness, time required to notify and assembly fire brigade, and selection, placement and use of equipment.

b. Assess each brigade member's knowledge of his role in the fire fighting strategy for the area assumed to contain the fire: Assess the brigade members conformance with established plant fire fighting procedures and use of fire fighting equipment, including self-contained emergency breathing apparatus, communication equipment, and ventilation equipment, to the extent practicable.

c. The simulated use of fire fighting equipment required to cope with the situation and type of fire selected for the drill. The area and type of fire chosen for the drill should be varied such that brigade members are trained in fighting fires in all safety related areas containing significant fire hazards. The situation selected should simulate the size and arrangement of a fire which could reasonably occur in the area selected, allowing for fire development due to the time required to respond, to obtain equipment, and organize for the fire, assuming loss of automatic suppression capability.

d. Assessment of brigade leader's direction of the fire fighting effort, as to thoroughness, accuracy, and effectiveness.

e. The drills should be performed at regular intervals but not to exceed 3 months for each fire brigade. At least one drill per year should be performed on a "back shift" for each fire brigade. A sufficient number of these drills, not less than one for each fire brigade per year, shall be unannounced, to determine the fire readiness of the plant fire brigade leader, brigade, fire protection systems and equipment.

f. The drills should be pre-planned to establish the training objectives of the drill. The drills should be critiqued to determine how well the training objectives have been met. Unannounced drills should have their critiques performed by members of the management staff responsible for plant safety and security. At three year intervals, drills should be critiqued by qualified individuals independent of the utility's staff.

4.0 Records

Records of training provided to each fire brigade member including drill critiques should be maintained to assure that each member receives training in all parts of the training program. These records of training should be available for review.

Attachment No. 5

FIRE FIGHTING PROCEDURES

Fire fighting procedures should be established to cover such items as notification of a fire, fire emergency procedures, and coordination of fire fighting activities with offsite fire departments. The fire fighting procecures should identify:

a. Actions to be taken by individual discovering the fire, such as, notification of control room; attempt to extinguish fire, and actuation of local fire suppression systems.

b. Actions to be taken by the control room operator and the need for brigade assistance upon report of a fire or receipt of alarm on control room annunciator panel, such as: announcing location of fire over PA system, sounding fire alarms and notifying the shift supervisor and the fire brigade leader of the type, size, and location of the fire.

c. Actions to be taken by the fire brigade after notification by the control room operator of a fire, including: location to assemble; directions given by fire brigade leader; and responsibilities of brigade members such as selection of fire fighting equipment and transportation to fire location, selection of protective equipment, use of fire suppression systems operating instructions, and use of preplanned strategies for fighting fires in specific areas.

d. The strategies established for fighting fires in all safety-related areas and areas presenting a hazard to safety-related equipment. As a minimum the following subjects should be covered:

   (1) Identification of combustibles in each plant zone covered by the specific fire fighting procedures.

   (2) Fire extinguishants best suited for controlling the fires associated with the combustible loadings in that zone and the nearest location of these extinguishants.

   (3) Most favorable direction from which to attack a fire in each area, in view of the ventilation direction, access hallways, stairs and doors which are most likely to be fire-free, and the best station or elevation for fighting the fire. A specific identification system shall designate all hallways, stairs, doors, fire equipment and system control locations, and other items described in the fire fighting procedures. This identification should be used

in the procedures and the corresponding plant items should be prominently marked so that they can be recognized in dim light. All access and egress routes that involve locked doors should be specifically identified in the procedure with the appropriate precautions and methods for access specified.

(4) Designation of plant systems that should be managed to reduce the damage potential during a local fire; location of local and remote controls for such management (e.g., any hydraulic or electrical systems in the zone covered by the specific fire fighting procedure that could increase the hazards in the area because of overpressurization or electrical hazards).

(5) Designation of vital heat-sensitive system components that should be kept cool while fighting a local fire. Critical equipment which are particularly hazardous combustible sources should be designated to receive cooling.

(6) Organization of fire fighting brigades and the assignment of special duties according to job title so that all fire fighting functions are covered by any complete shift personnel complement. These duties should include command control of the brigade, fire hose laying, applying the extinguishant to the fire, advancing support supplies to the fire scene, communication with the control room, coordination with outside fire departments.

(7) Identification radiological and toxic hazards in fire zones.

(8) Ventilation system operation that assures desired plant pressure distribution when the ventilation flow is modified for fire containment or smoke clearing operations.

(9) Operations requiring control room and shift engineer coordination or authorization.

(10) Instructions for plant operators and general plant personnel during fire.

e. The validity of the preplanning strategies should be tested by appropriate full-dress drills to check the logic of the strategy, the adequacy of the equipment, personnel understanding, and to uncover unforeseen problems.

f. Actions to be taken by Plant Superintendent and his staff, and Security Guards after notification of a fire.

g. Actions to be taken that will coordinate fire fighting activities with offsite fire departments, including: identification of individual responsible for assessing situation and calling in outside fire department assistance when needed; identification of individual who will direct fire fighting activities when aided by offsite fire fighting assistance; provisions for including offsite fire fighting organizations in fire brigade drills at least once per year; and provisions for training offsite fire department personnel in basic radiation principles, typical radiation hazards, and precautions to be taken in a fire involving radioactive materials in the plant. The procedures should also describe the offsite fire department's resources and estimated response time by the offsite fire department to provice assistance to the station.