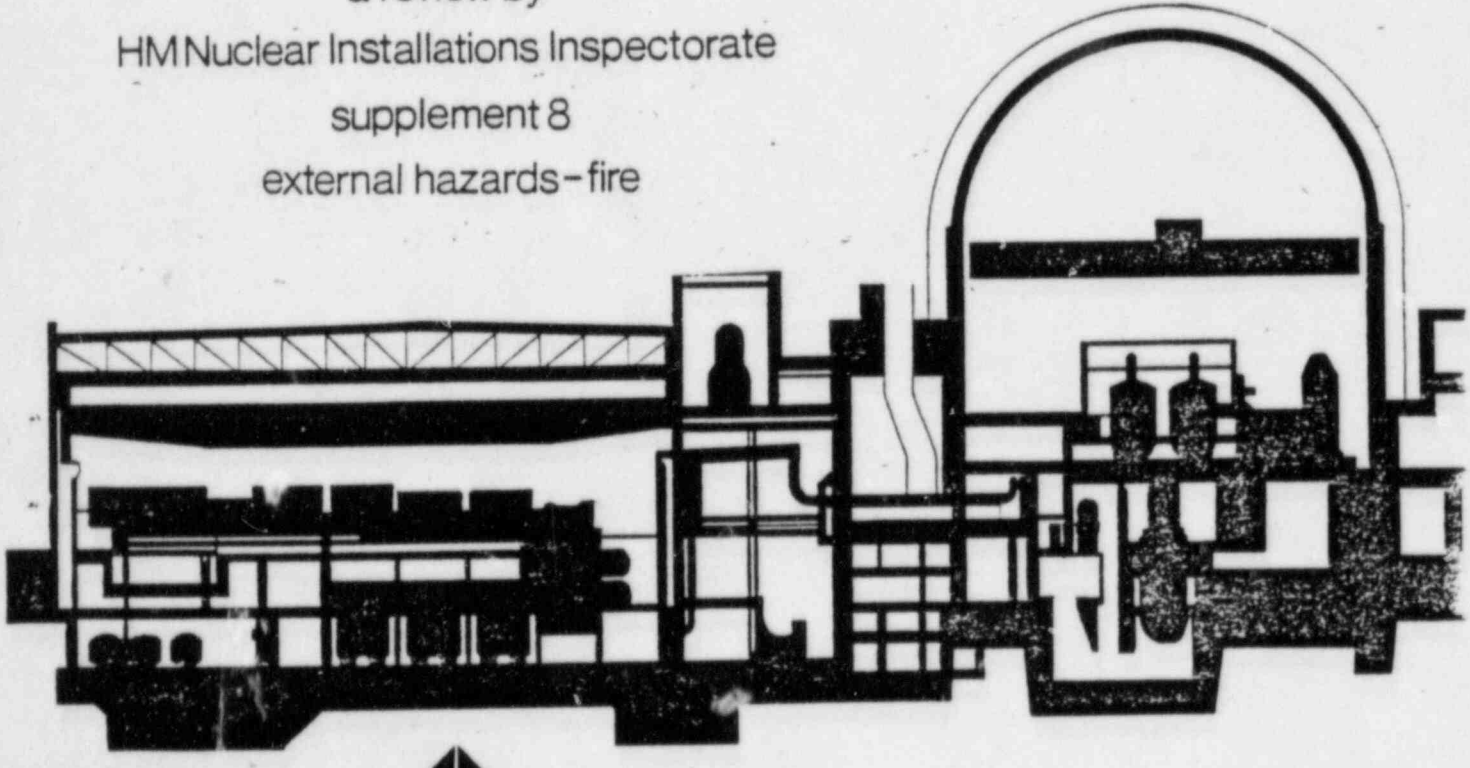
NII 01 (SUPP 8)

Sizewell B

a review by
HM Nuclear Installations Inspectorate
supplement 8
external hazards - fire



Sizewell B

A review by HM Nuclear Installations Inspectorate
Supplement 8: External hazards – fire NII 01 (SUPP 8)

Health and Safety Executive
March 1983

CONTENTS

ERRATUM

In Section 5.6 paragraph 36 penultimate sentence.
The reference to the Annexes should read "(Annexes IV and X)

1 INTRODUCTION

1 In July 1982 the Nuclear Installations Inspectorate published its Review (ref 1) of the Central Electricity Generating Board's (CEGB) Pre-Construction Safety Report (PCSR) (ref 2). One of the conclusions of the Review was that some important areas remained where the position was not yet satisfactory. One of these areas was that relating to fire, about which it was further concluded that "an improved case needs to be made or design changes may be required". The Inspectorate's commentary on fire is presented in paragraphs 4.30 to 4.41 of the Review and it is also referred to in paragraphs 11.15 and 11.66(b).

2 Since publication of the Review a number of meetings have been held with the CEGB and the National Nuclear Corporation (NNC) and several documents have been exchanged with the most recent submission, PWR/R684 Issue B (ref 3)*, being made in late December 1982. Henceforth reference to R684 is to Issue B.

3 In R684 the CEGB has responded to the Review on an issue by issue basis rather than dealing with each paragraph sequentially. As this report also adopts a different format from the Review cross references to the principal documents are given in parenthesis. The cross references are identified in the following manner:-

(a) The Review - Review followed by the paragraph number

(b) The PCSR - PCSR followed by the page number

(c) R series reports - the report number followed by either the page number or the section reference where appropriate.

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* R684 and many other supporting reports are NNC documents which are endorsed by the CEGB and constitute part of its safety case. See however paragraph 13 in section 3.

4 This Supplementary Report provides the Inspectorate's view on the changes which have been made to the design and safety case by the CEGB since publication of the Review and takes into account all information received up to 28 January 1983.

2 THE SAFETY CASE

5 The CEGB's safety case on fire is set out in chapters 3.3.1.2 and 9.5.1 of the PCSR and in reports PWR/R398 (ref 4) and PWR/R684. It is based on a defence in depth concept (R684 page 3) which is aimed at achieving an acceptable balance in:-

(a) preventing fires from starting;

(b) detecting and extinguishing quickly those fires which do start;

(c) protecting sufficient plant required for nuclear safety from fires which may start and are not quickly extinguished.

6 Fire prevention techniques (PCSR page 3.3/5) aim at reducing the probability of occurrence of a fire by:-

(a) reducing the inventory of combustible materials by using non-combustible or fire retardant materials where possible;

(b) designing and constructing all plant systems so that their operation or failure gives the minimum risk of fire;

(c) protecting items important to safety from those natural phenomena such as earthquakes and extreme winds which could give rise to a fire;

(d) minimising the on-site use and storage and controlling the movement of combustible materials in areas adjacent to or containing items important to safety;

(e) taking special precautions with regard to equipment containing flammable fuels or lubricating oil (eg by providing bund walls);

(f) controlling work having the potential for causing fire.

7 The CEGB gives information on the fire detection and suppression systems which are to be installed (PCSR section 9.5.1) and identifies uses for specific systems (R684 page 19) eg automatic wet pipe sprinkler systems in cable risers and Halon total flooding systems in enclosed areas containing electrical switch gear. All buildings are to be equipped with fire detection and suppression systems (R684 page 19).

8 The third aspect of the defence in depth strategy is mitigation (PCSR page 3.3/6) which is aimed at protecting the safeguards systems in one fire area from the effects of a fire in another area (which may contain convential or safeguards plant) such that the reactor can be brought to a safe shutdown state with sufficient reliability. The CEGB has segregated plant necessary for achieving and maintaining a safe shutdown state by allocating it to different separation groups (R398 pages 29-30 and R684 pages 15-16). The overall strategy outlined by the CEGB (R684 section 2.1) leads to the following general segregation provisions (R684 page 6):-

(a) 4-way for that equipment necesssary for hot shutdown.

(b) 4-way for the primary protection system.

(c) 2-way for the secondary protection system.

(d) 2-way for all other safety systems (including those required for cold shutdown).

9 Safety-related cabling is divided into four safety-related separation groups numbered 1, 2, 3 and 4. Non safety-related cables are divided into two non safety-related separation groups numbered 5

and 6 (R398 page 15). It should be noted that the terminology used is that of the CEGB.

10 The mitigation strategy (R684 page 4) is to divide all buildings surrounding the reactor building and containing essential safeguards equipment into principal fire areas delineated by principal fire barriers. The CEGB judges (R684 page 11) that the 3 hour rating of the principal and other barriers in the plant is adequate to contain a fire adjacent to the barriers.

3 CHANGES SINCE PUBLICATION OF THE NII REVIEW

11 Since publication of the Review changes have been made in order to improve the safety case with respect to fire. These changes are given in R684. In this section the major changes are identified and a brief explanation of the reasons for the changes is given. Further discussion of the effect that each of the changes has had on the Inspectorate's view of the safety case is contained in sections 5 and 6.

12 The principal changes have been :-

(a) The degree of segregation of the primary protection system has been increased from 2-way to 4-way (R398 page 36 and R684 page 6). The increased segregation is to enable the primary protection system to meet additionally the single failure criterion during a fire.

(b) The repositioning of the motor driven auxiliary feed water pumps (R684 page 2). The change is to facilitate the segregation of this plant and its cabling.

(c) The resiting of the component cooling water heat exchangers in the basement of the control building (R684 page 2). This change, besides eliminating sea water from the auxiliary building, provides additional space to permit improvement in segregation standards. Consideration is also being given to the relocation of the four component cooling water pumps.

(d) The provision of two further cable penetration rooms (R398 page 13 and R684 page 8). The increase in number of cable penetration rooms from 2 to 4 is in order to improve segregation standards.

(e) The rerouting of heating, ventilation and air conditioning (HVAC) ducting in order to reduce the number of penetrations between segregation areas (R684 page 6).

(f) The incorporation of full segregation into the HVAC systems serving the areas of the control building housing protection and essential safety features actuation systems (ESFAS) cabinets (PCSR page 9.4/3 and R684 page 8). This provision reduces the number of penetrations between different segregation areas.

(g) The application of fire segregation standards rather than electrical segregation standards to equipment necessary to achieve, monitor and maintain safe shutdown (R398 section 3.4 and R684 page 4). Electrical segregation is a lower standard as it protects against electrically initiated fires but not against exposure fires. An exposure fire is one which begins external to the cabling, for example burning rubbish, rather than internally, for example a cable fault.

13 All of the changes proposed are subject to internal NNC and CEGB review and approval. The Inspectorate has recently asked the CEGB to confirm whether those changes reported in R684 have completed this internal process. Although no formal reply had been received at the time of writing it is understood that all remain to be approved.

14 A result of the changes having been introduced during the preparation of reports R398, R686 (ref 5) and R684 is that these reports contain statements which contradict one another and the PCSR. In order to avoid confusion the Inspectorate considers that a further report should be prepared which fully presents the CEGB's current safety case and removes the contradictory statements.

4 THE INSPECTORATE'S APPROACH TO THE ASSESSMENT

15 The Inspectorate's Safety Assessment Principles (ref 6) outline its approach to hazards, one of which is fire. Sections 3.5 which considers protection systems, 3.14 which deals with layout and 3.15 external hazards set down the general guidance. The particular principles which have been used are:-

(a) Principles 128 and 258 - layout to minimise the effects of fire.

(b) Principles 130 and 259 - the achievement of safe shutdown and cooling in the event of a fire.

(c) Principle 279 - identification of all sources which could give rise to a fire.

(d) Principle 281 - segregation and isolation of flammable substances, the protection of the nuclear plant and personnel, the provision of monitoring and alarm equipment and the provision of appropriate countermeasures.

16 In assessing the safety case presented by the CEGB the Inspectorate has looked for a hierarchical approach to protection against fire. Principle 29 of the Safety Assessment Principles indicates that there is a preferred order of protection such that the sensitivity of the plant to faults is minimised. In descending order the preference is that:-

(a) There should be no significant operational response in the plant.

(b) Any change in the plant state should be towards a safer condition.

(c) The plant should be rendered safe by the action of engineered safeguards which are continuously available in the state required.

(d) The plant should be rendered safe by the action of engineered safeguards which need to be brought into service.

17 The Inspectorate considers that the use of physical barriers between redundant or diverse trains of protection achieves the higher levels of preference of this principle. It has therefore said that it requires the trains of protection equipment to be segregated by physical barriers (Review paragraph 4.36). The degree of segregation should be such that, assuming loss of plant in the fire affected area, sufficient equipment remains to perform the necessary safety functions reliably (Review paragraph 11.15). In some circumstances a fire may cause maloperation of equipment which could have a more severe effect than total loss. The Inspectorate considers this possibility, particularly in connection with control and safety-related instrumentation. It wishes to be satisfied that the consequential effects of a fire cannot lead to faults beyond the design basis. Determination of the equipment required to perform the necessary safety functions depends upon:-

(a) The frequency of a fire as an initiating event.

(b) Those random faults which may reasonably be postulated to occur coincident with a fire.

18 Given the appropriate degree of segregation the Inspectorate then considers the standard of segregation which is achieved (Review paragraph 4.37). If the barriers between areas containing redundant or diverse plant are suitably rated structural elements which are not penetrated by such things as doors, pipes, cables or ducting it could reasonably be argued that a fire would not breach the barrier. The effect of a fire would then be equivalent to the loss of a train of essential systems which is itself within the design basis. The Inspectorate has stated (Review paragraph 4.37) that it expects the barriers to be imperforate fire resistant structures so far as is reasonably practicable.

19 In the Review the Inspectorate also accepted that it is not always practicable to achieve this standard (Review paragraph 4.37), for example doors are required for access and equipment within an area needs power and services. The Inspectorate considers that where a reduction from the absolute standard is necessary other aspects of the fire protection strategy should be utilised in order to compensate for the relative weakness introduced. The aim is to reduce the probability of failure of the penetrated barrier when subjected to a fire by reducing preferably both the frequency and the severity of the challenge which may be placed upon it (Review 4.32 et seq).

5 CURRENT POSITION ON GENERAL STRATEGY

5.1 Overview

20 In reviewing the current position this section examines:-

(a) Those systems needed to achieve, monitor and maintain a safe state.

(b) The degree of segregation required.

(c) The methods of achieving segregation.

(d) Penetrations in barriers.

(e) Reduction of the frequency of occurrence of fires.

(f) Reduction of the severity of fires which do occur.

5.2 Systems Needed to Achieve, Monitor and Maintain a Safe State

21 In sections 3 and 4 of R398 the CEGB identifies those systems necessary to bring the reactor subcritical, to remove decay heat and to maintain it in a safe state. The report considers only that equipment needed for a normal shutdown or a shutdown following a spurious reactor trip together with loss of off-site power (R398 page 5). The

CEGB's argument for limiting its consideration in this way is that the probability of the combined event of a fire and a fault is such that the number of effective safeguards trains required is less than that required by the deterministic approach (R398 section 2). In the deterministic approach the CEGB requires that adequate equipment is available following any single hazard or fault to ensure that the plant can be brought to and maintained in a safe shutdown condition taking into account the effects of a single active failure, the maintenance of equipment and the loss of offsite power.

22 The Inspectorate has informed the CEGB that it is not entirely convinced with its argument and that it requires consideration of a fire coincident with the more frequent faults such as loss of main feed, spurious opening of relief or safety valves and boron dilution faults. The basis for the Inspectorate's position is derived from the frequency of fire as an initiating event, the time at risk and the need for it to be shown that no sudden unacceptable increase in the predicted consequences exists just beyond the design basis.

23 All systems which perform a necessary safety function, either directly or indirectly, can be identified once the coincident faults to be considered are determined. At this stage the CEGB has merely identified those systems directly required for achieving hot and ultimately cold shutdown (R398 sections 3 and 4). The CEGB omits to identify any other systems which may be necessary to mitigate the consequences of a coincident fault or to consider any of the supporting services upon which the essential systems depend. In the Inspectorate's terminology all of these systems are classed as Protection. In the Review the Inspectorate criticised the failure to supply a comprehensive protection schedule (Review paragraph 11.11). The difficulty of determining which systems require to be segregated is an example of why such a schedule is necessary. Paragraph 11.11 of the Inspectorate's Suplementary Report Supp 6 - Protection Systems (ref 7) discusses the current position relating to the provision of a protection schedule.

5.3 Degree of Segregation

24 Having identified the need for segregation the next step is to determine the degree of segregation which is required (Review paragraph 11.15). As described in section 5.2 above the CEGB has used a deterministic approach which considers one segregation group to be lost in the fire, a second to be out on maintenance and the third to fail on demand. This results in a need for 4-way segregation. Figures 1-6 indicate the way in which the CEGB proposes to implement its strategy. The drawings are identical to figures 1-6 of Report R684 except that the different segregation groups have been highlighted by colour coding. 4-way segregation has been provided for that equipment necessary for hot shutdown and now includes those systems which the CEGB terms the primary protection system. The provision of such segregation for the primary protection system is a significant improvement on the case as presented in the PCSR. It has resulted in a system which will be more effective in its ability to detect a fault and initiate protective actions during a fire.

25 Additional equipment is necessary in order to remain at hot shutdown or to progress via intermediate shutdown to cold shutdown (R398 sections 3.1, 3.2 and 3.3). The CEGB argues that as hot shutdown is a safe and stable state there is ample time available before the additional equipment is required. The degree of segregation for it may therefore be reduced to the 2-way segregation proposed (R684 page 4). For the argument to be valid it would be necessary to accept the principle that repair of failures or reinstatement of equipment under maintenance is permissible (R684 page 4). While not rejecting this premise out of hand the Inspectorate would expect to be given a more comprehensive argument to substantiate any specific argument. For example a similar argument has been presented in considering the frequency of loss of off-site power (ref 8). Before the Inspectorate could accept the repair/reinstatement argument it would expect to receive a case based upon:-

(a) Demonstration that providing the necessary segregation is not reasonably practicable.

(b) The work which may be necessary at the time of the fire.

(c) The time available to perform the tasks.

(d) The consequences of failure to complete the tasks in the allotted time.

26 A further aspect of the degree of segregation which the Inspectorate has questioned (Review paragraphs 11.29 and 11.75) relates to control systems and safety-related instrumentation (as defined in the introduction to section 3.5 of ref 6). It is uncertain whether such equipment is to be allocated to segregation groups 1 to 4 or to groups 5 and 6 which are deemed by the CEGB to be non safety-related (R398 page 15). The Inspectorate is concerned on two points, the first being that a fire can cause multiple control system faults beyond the design basis of the protection system. In the second it wishes to ensure that safety-related instrumentation which is required during and following a fire is sufficiently segregated. In addition segregation groups 5 and 6 contain approximately 90% of all cables in the station and the impact they may have on safety has not yet been considered by the CEGB. The impact may arise directly by failure or spurious operation of the systems or indirectly by affecting adjacent essential plant and cables.

27 Some progress has been made since publication of the Review in that the need to examine these subjects has been accepted by the CEGB. The CEGB has undertaken to identify the safety related aspects of non 1E equipment (R686 section 11.12) and to consider fire induced multiple control system faults (R686 section 11.29).

28 While welcoming the progress which has been made the Inspectorate reserves its position until the information promised has been received and assessed.

5.4 Method of Segregation

29 The next aspect is the method of achieving segregation and is arguably the area where the greatest improvement has been made. The

CEGB has stated that segregation is to be achieved by physical barriers of at least three hour rating (R684 page 6). Thus abandoning reliance on equivalent standards of protection which was criticised by the Inspectorate (Review paragraph 4.36).

30 Outside the containment, segregation against fire is to be provided almost totally by structural fire barriers. A small number of exceptions to this principle have been identified by the CEGB (R684 page 16) but assurance has been given that these are exceptions and that each case is to be justified on its own merits. R684 gives examples such as the incorporation of position interlocks on groups of valves and the use of multiple instrumentation sensors on a single piece of equipment.

31 The abandonment of the equivalent standard argument which used a lower rated barrier or physical separation, both associated with fire detection and suppression equipment, instead of a fully rated structural barrier is a significant improvement in the safety case in that a higher standard of segregation is being achieved. The standard of segregation between groups 1 and 4 (R684 page 15) has also been improved. The improvement can be seen most easily by comparing figures 2-6 with drawings IKC-K0399 to IKC-K0403 in chapter 1 of the PCSR. The barrier between groups 1 and 4 is especially important as it is the principle division between the 2-way segregated systems necessary for cold shutdown.

32 Although the Inspectorate would prefer to see the barriers as appropriately rated imperforate structural elements it was accepted that it may not always be reasonably practicable to provide this. The Inspectorate therefore wishes to be assured that the number of penetrations between different segregation areas are being kept to a minimum and that the magnitude of the challenge to those penetrations has also been minimised.

33 On a historical note the worst fire to have occurred in a nuclear power station, that at Browns Ferry in March 1975, spread from a cable spreading room into the reactor building via a penetration (ref 9). The structural barrier itself merely suffered slight spalling of the

concrete. Many lessons were learned from the fire, the principal one being the need to ensure adequate segregation between redundant trains of equipment.

5.5 Penetrations in Barriers

34 The fourth aspect is the reduction in the number of penetrations between segregated groups (Review paragraph 4.37). Numerous improvements have been made including rerouting HVAC ducting so that it does not directly connect different segregation groups in the auxiliary building (R684 page 6). In the control building protection equipment rooms are to be provided with HVAC systems each dedicated to serve a single segregation group (R684 page 8). The Inspectorate welcomes the reduction in the number of penetrations of all types between segregated areas. While it has informed the CEGB that it still considers further reduction to be possible the Inspectorate nevertheless acknowledges that considerable progress has been made in this area. As the detailed design develops particular attention will be paid to those penetrations linking the important group 1 and 4 areas.

5.6 Reduction of the Frequency of Occurrence of Fires

35 The penultimate aspect is the reduction of the probability of fire. It is principally achieved by traditional fire prevention techniques (PCSR pages 3.3/5 and 6) which are listed in paragraph 6 above.

36 In the Review (paragraph 4.41) the Inspectorate reported that it agreed with the basic fire protection strategy but that it had reservations in some areas. One of these areas was the routing of cables which is discussed further in paragraphs 4.38 and 4.39 of the Review. Concern was expressed that the practice of using plant rooms and corridors for routing cables was contrary to the basic fire prevention rule of separating a fire load from ignition risks (Review paragraph 4.38). As stated earlier, if perfect segregation between redundant equipment were achieved, such routing would have only a limited effect on nuclear safety. However as this is not the case the

Inspectorate believes that the routing proposed could lead to an increase in both the probability and severity of a fire. The approach, which is described in Section 7 of R684, is also contrary to the CEGB's own Design Safety Guidelines (ref 10) (Annexes II and IV). No progress has been made on resolving this issue and the Inspectorate's reservation remains.

5.7 Reduction of the Severity of Fires

37 The final consideration is the reduction in the severity of any fires which may start. One way - that of separating ignition risk from fire load so that most fires which do start have a small fire load - has already been discussed in connection with cable routing. Further methods are to provide appropriate fire detection and extinguishing systems and to restrict the temperature rise associated with a fire by venting smoke and heat.

38 The CEGB's strategy for the provision of fire detection and extinguishing systems is that appropriate equipment is supplied to ensure the early detection and suppression of fires (PCSR page 3.3/6). Certain areas are able to be identified early in the design when the specific protection can be defined, for example the turbine generators and computer suites. In other areas the intent is given, for example the provision of linear heat detector operated sprinkler systems in cable routes (R684 page 19). The Inspectorate has stated in the Review (paragraph 4.41) that it broadly accepts the strategy outlined with the possible exception of that provided in the reactor coolant pump compartments. This topic is discussed further in section 6.2 below.

39 An aspect of the strategy for providing fire extinguishing systems which the Inspectorate does not consider to be adequately developed is that relating to spurious operation (PCSR page 3.3/6). Spurious operation of fire extinguishing systems has been discussed with the CEGB and the NNC and it had been indicated that equipment within the area of discharge will be examined. In view of the known difficulties caused by flooding and seepage when such systems operate

the Inspectorate would expect the CEGB to analyse also the hazard to equipment located in the area below that which is affected directly. One further concern of the Inspectorate is that the proposal, discussed above, to route cables through plant rooms and corridors may lead to an enhanced spurious actuation rate for the fire extinguishing systems provided to protect the cables.

40 The other method of reducing the severity of any fire which may start is the provision of means for venting smoke and heat. Section 6.2. of R684 gives the CEGB's strategy for dealing with smoke and heat which is based upon containment within the fire area. A US Nuclear Regulatory Commission report (ref 11) gives the benefits of venting as:-

(a) A slower growth rate for the fire.

(b) Limitation of the extent of the fire involvement.

(c) Reduction in the peak temperature achieved and therefore a lower probability of structural damage.

(d) Better control of fire spread by reducing the differential pressure between zones.

(e) Improved accessibility.

41 The removal of smoke and heat is another area where no progress has been made since the receipt of R398.

6 SPECIFIC MATTERS

6.1 Protection of Personnel

42 In the Review (paragraph 4.34) the Inspectorate criticised the CEGB for not adequately dealing with personnel safety in the PCSR. The CEGB has confirmed (R684 page 25) that it regards the provision of an adequate number of escape routes as an additional important design feature. This confirmation satisfies the Inspectorate as it clearly

states the CEGB's strategy. Its implementation will require to be discussed as the detailed design proceeds to ensure that the conflicting factors identified by the CEGB (R684 page 4) are adequately considered. The relevant legislation referred to by the CEGB (R684 pages 4 and 25) is the Fire Certificates (Special Premises) Regulations 1976.

6.2 Reactor Coolant Pump Fire

43 Since the Inspectorate's comment in the Review (paragraph 4.40), the CEGB has undertaken to analyse a fire occurring at a reactor coolant pump (RCP) (R684 page 27). Initially worst case assumptions are to be made in the examination of its effect on RCP and steam generator supports. The analysis is welcomed as it is aiming to identify the specific risk before progressing to the requirement for protection. The results were promised for the end of 1982 but the Inspectorate has not yet received them. While it retains the reservation expressed in the Review the Inspectorate considers that resolution of the issue can be achieved without significant changes to layout.

6.3 Fire Following an Aircraft Crash

44 The main safety case on aircraft crash is presented in the CEGB's report GD/PE-N/403 (ref 12). It is commented upon in the Inspectorate's Supplementary Report; External Hazards - Aircraft Crash (ref 13). The safety case for fire following an aircraft crash (Review paragraph 5.20) is contained in section 10 of R684 and was first received in late December 1982. There has been insufficient time to discuss this subject further with the CEGB.

45 The CEGB bases its case on the argument that fire damage associated with an aircraft crash falls into two main categories (R684 page 31):-

(a) Damage caused by fires without significant structural damage.

(b) Damage caused by fire following structural damage to a building (including mechanical damage to plant).

It also argues that the design provisions for protection against internally generated fires will be of benefit in limiting fire damage associated with an aircraft crash (R684 page 30).

46 The Inspectorate agrees with the logic of the argument presented in section 10 of R684 but it considers that the supporting evidence provided is weak. It is understood that the CEGB is undertaking further studies in order to provide such evidence. To enable it to assess the safety case on fire following an aircraft crash the Inspectorate would expect the further studies to include:-

(a) An estimate of the fuel load which was considered in the analysis.

(b) An analysis which considers the crash affecting all buildings and not just those housing protection equipment. A US Nuclear Regulatory Commission report (Ref 14) recently reviewed suggests that consequential multiple failures in non safety systems may have an effect on reactor safety.

(c) An analysis which considers other areas of the site where a fire may have safety implications. For example the CEGB's report on aircraft crash dismisses simultaneous loss of the reserve ultimate heat sink and the sea water pump house as a very low probability event because of the unique approach direction and angle needed. Examination of Figure 1, which shows the routing of essential cables, indicates that it may be possible for all supplies to both systems to be lost simultaneously with a higher probability than is suggested in the report.

7 CONCLUSIONS

47 The Inspectorate acknowledges that significant improvements have been made in a number of areas of the safety case concerning fire. These areas include:-

(a) An increase in the degree of segregation of the primary protection system (R684 page 6).

(b) Layout changes in order to achieve a higher standard of segregation (R684 pages 2, 6 and 8).

(c) The provision of two additional cable penetration rooms (R684 page 8).

(d) Reduction in the number of penetrations in structural fire barriers (R684 page 6).

(e) Confirmation that consideration of safety of personnel is regarded as providing an important input to design (R684 pages 24 and 25).

48 Areas remain however where the Inspectorate is still not satisfied with the safety case and where it cannot yet be confirmed that changes to plant or layout will not be necessary. These are:-

(a) The study of faults which may occur coincident with a fire (R398 page 5).

(b) The ability to reach cold depressurised shutdown in an appropriate timescale (R684 page 6). However a more comprehensive argument to support the case may suffice to remove this reservation.

(c) Segregation requirements for control systems, safety-related instrumentation and equipment allocated to groups 5 and 6 (R686 sections 11.12 and 11.29).

(d) Further reduction in the number of penetrations in principle fire barriers (R684 page 10).

(e) Routing of cables through corridors and plant rooms (R684 section 7).

(f) Spurious operation of fire suppression systems (PCSR page 3.3/6 and R684 page 19).

(g) The strategy for smoke and heat removal (R684 section 6.2).

(h) The analysis of fire following aircraft crash (R684 section 10).

49 Since publication of the PCSR significant changes have taken place leading to contradictory statements being present in the various documents which have been submitted. The Inspectorate considers that sufficient changes have now occurred to warrant the production of a new document which presents the full safety case for fire.

HM NII,
March 1983

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14. NUREG CR/2859 Evaluation of Aircraft Crash Hazards for Nuclear Power Plant. US Nuclear Regulatory Commission 1981.

9 FIGURES

Figure	Title
Fig 1	Major Safety Cable Routes
Fig 2	Auxiliary Building - Arrangement of Cable Segregation Groups showing Principal Fire Barriers and their Penetrations. Plan at - 1.55 m.
Fig 3	Auxiliary Building - Arrangement of Cable Segregation Groups showing Principal Fire Barriers and their Penetrations. Plan at + 2.77 m.
Fig 4	Auxiliary Building - Arrangement of Cable Segregation Groups showing Principal Fire Barriers and their Penetrations. Plan at + 6.55 m.
Fig 5	Auxiliary Building - Arrangement of Cable Segregation Groups showing Principal Fire Barriers and their Penetrations. Plan at + 14.47 m.
Fig 6	Auxiliary Building - Arrangement of Cable Segregation Groups showing Principal Fire Barriers and their Penetrations. Plan at + 21.13 m.

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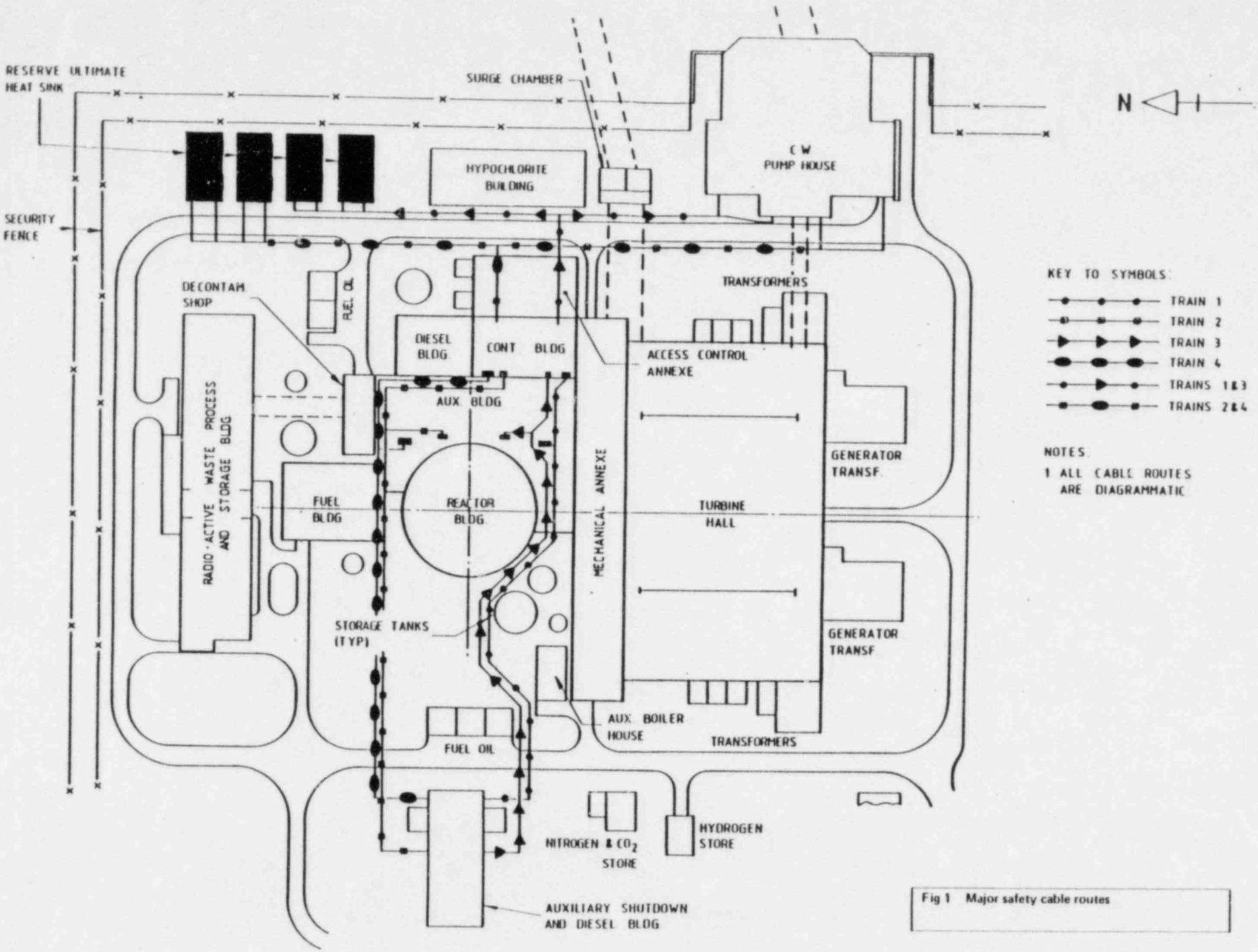
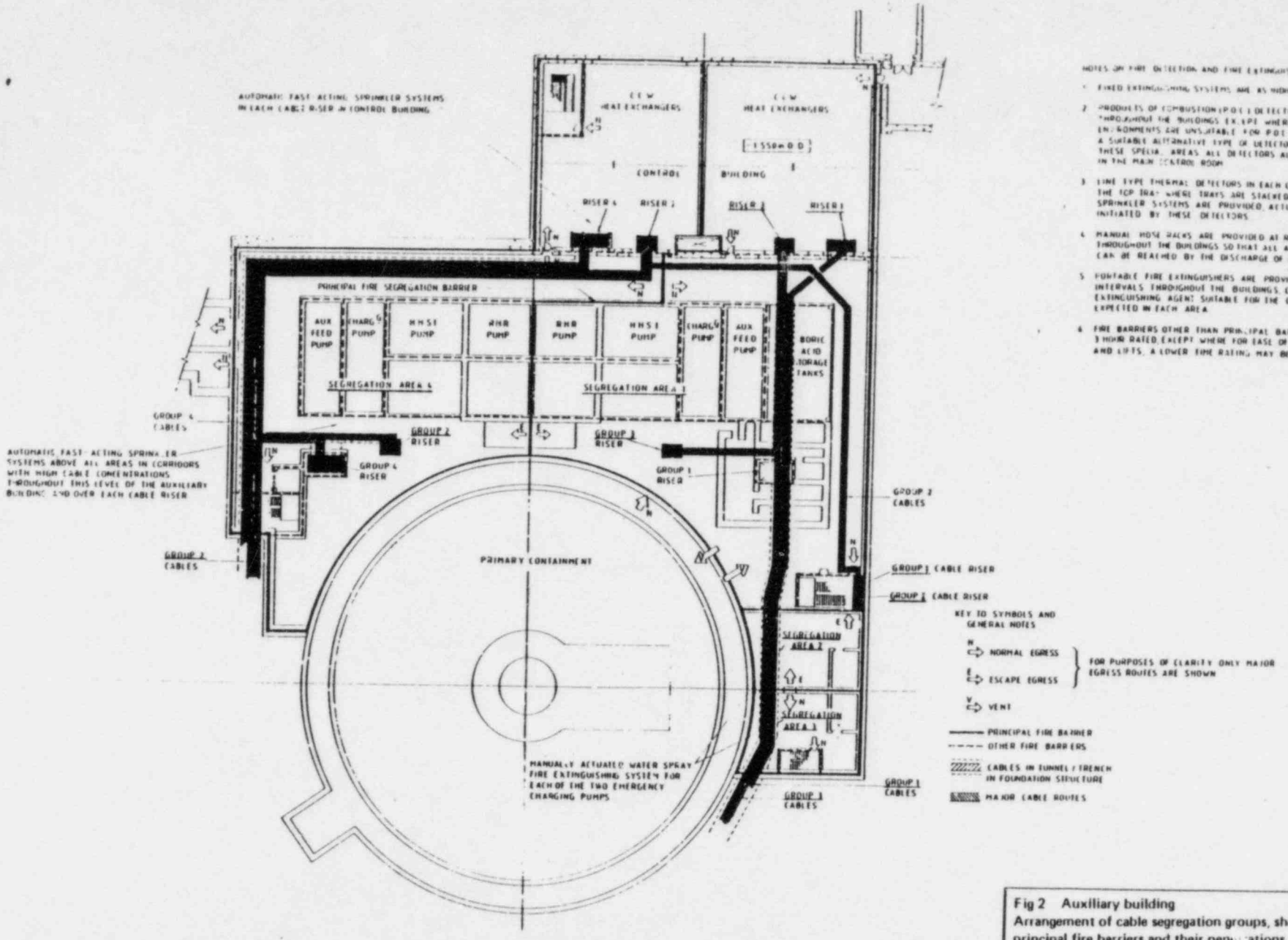


Fig 1 Major safety cable routes



PLAN AT ▽-1·55m OD

NOTES ON FIRE DETECTION AND FIRE EXTINGUISHING DESIGN PROVISIONS

1 FIXED EXTINGUISHING SYSTEMS ARE AS INDICATED ON THESE DRAWINGS

2 PRODUCTS OF COMBUSTION (POC) DETECTORS ARE PROVIDED THROUGHOUT THE BUILDINGS EXCEPT WHERE NORMAL AREA ENVIRONMENTS ARE UNSUITABLE FOR POC DETECTORS. A SUITABLE ALTERNATIVE TYPE OF DETECTOR IS PROVIDED FOR THESE SPECIAL AREAS. ALL DETECTORS ALARM LOCALLY AND IN THE MAIN CONTROL ROOM

3 LINE TYPE THERMAL DETECTORS IN EACH CABLE TRAY OR ON THE TOP TRAY WHERE TRAYS ARE STACKED. WHERE FAST ACTING SPRINKLER SYSTEMS ARE PROVIDED, ACTUATION WILL BE INITIATED BY THESE DETECTORS

4 MANUAL HOSE RACKS ARE PROVIDED AT REGULAR INTERVALS THROUGHOUT THE BUILDINGS SO THAT ALL AREAS OF THE BUILDINGS CAN BE REACHED BY THE DISCHARGE OF AT LEAST ONE HOSE

5 PORTABLE FIRE EXTINGUISHERS ARE PROVIDED AT REGULAR INTERVALS THROUGHOUT THE BUILDINGS, CHARGED WITH A FIRE EXTINGUISHING AGENT SUITABLE FOR THE COMBUSTIBLE MATERIALS EXPECTED IN EACH AREA

6 FIRE BARRIERS OTHER THAN PRINCIPAL BARRIERS ARE 3 HOUR RATED, EXCEPT WHERE FOR EASE OF ACCESS TO STAIRS AND LIFTS, A LOWER FIRE RATING MAY BE USED

Fig 2 Auxiliary building
Arrangement of cable segregation groups, showing principal fire barriers and their penetrations

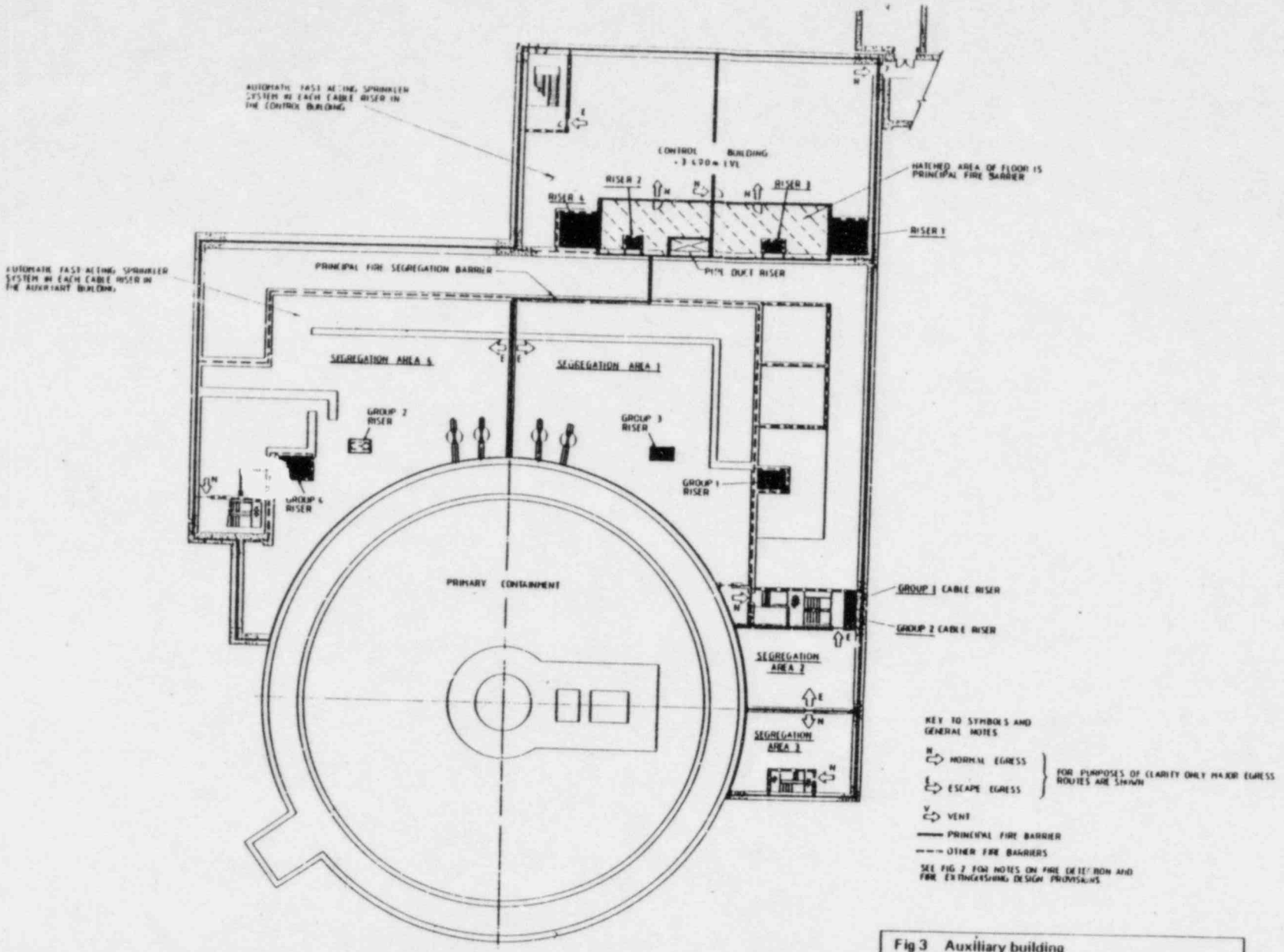


Fig 3 Auxiliary building
Arrangement of cable segregation groups showing principal fire barriers and their penetrations

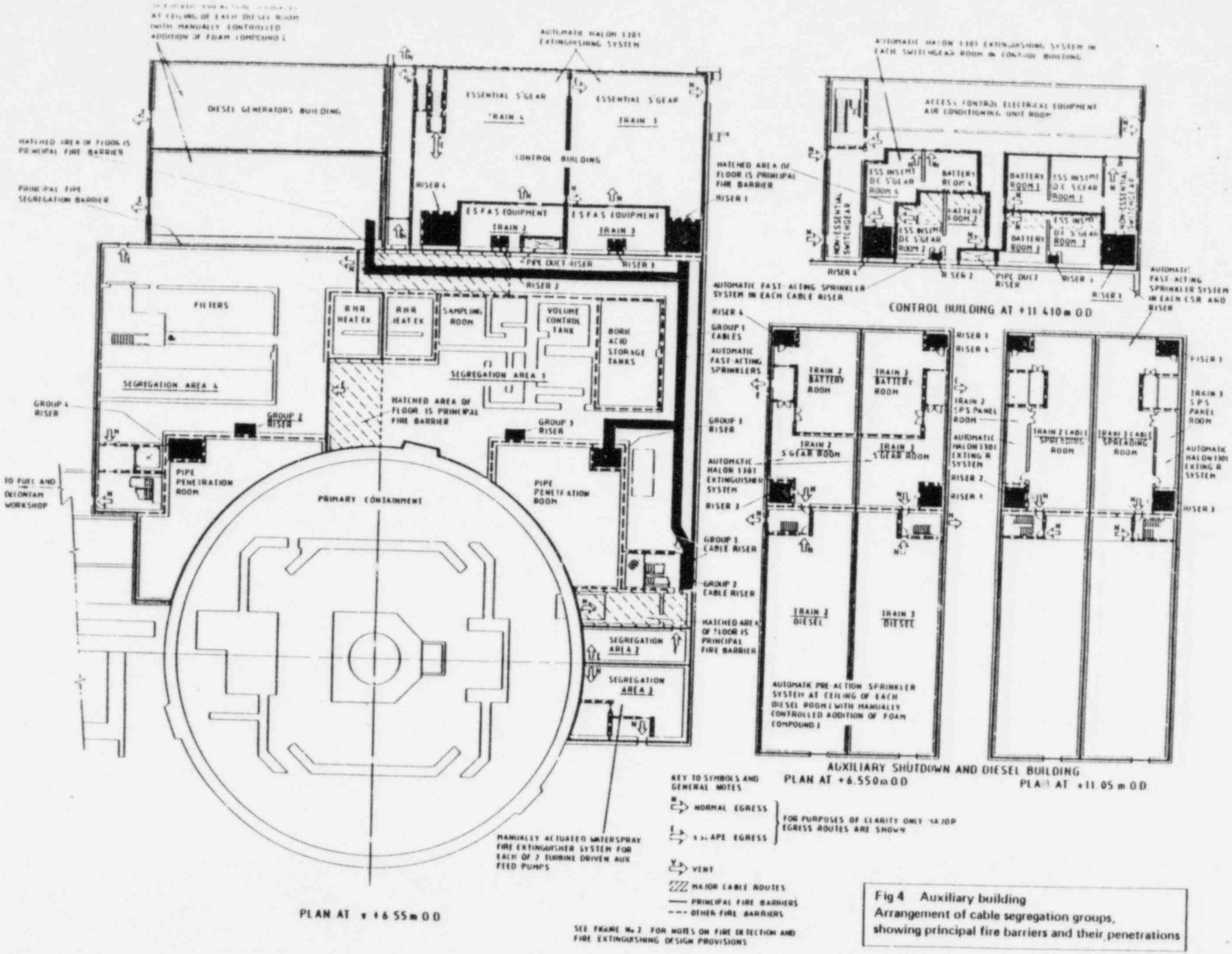


Fig 4 Auxiliary building
Arrangement of cable segregation groups, showing principal fire barriers and their penetrations

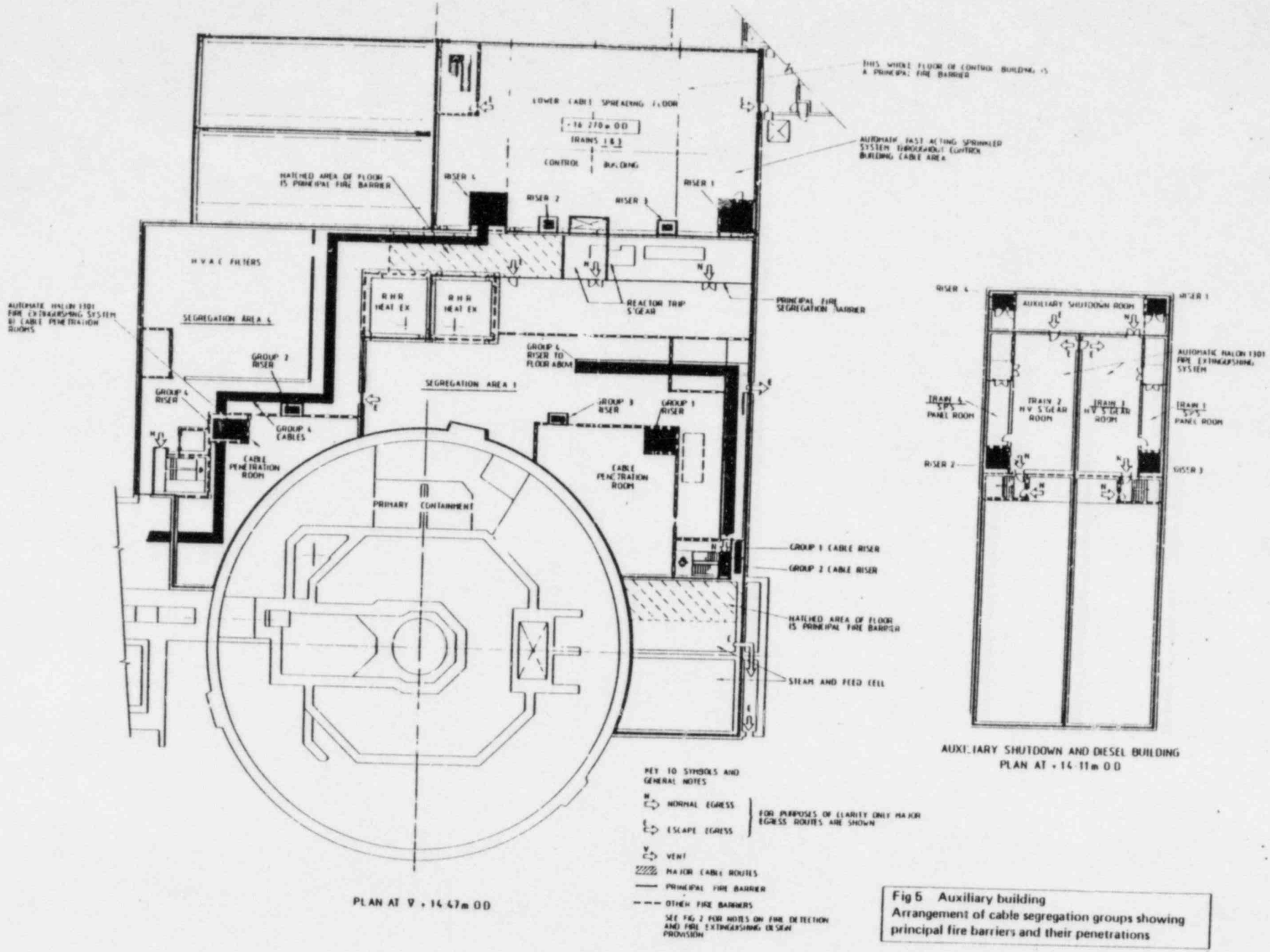


Fig 5 Auxiliary building
Arrangement of cable segregation groups showing principal fire barriers and their penetrations

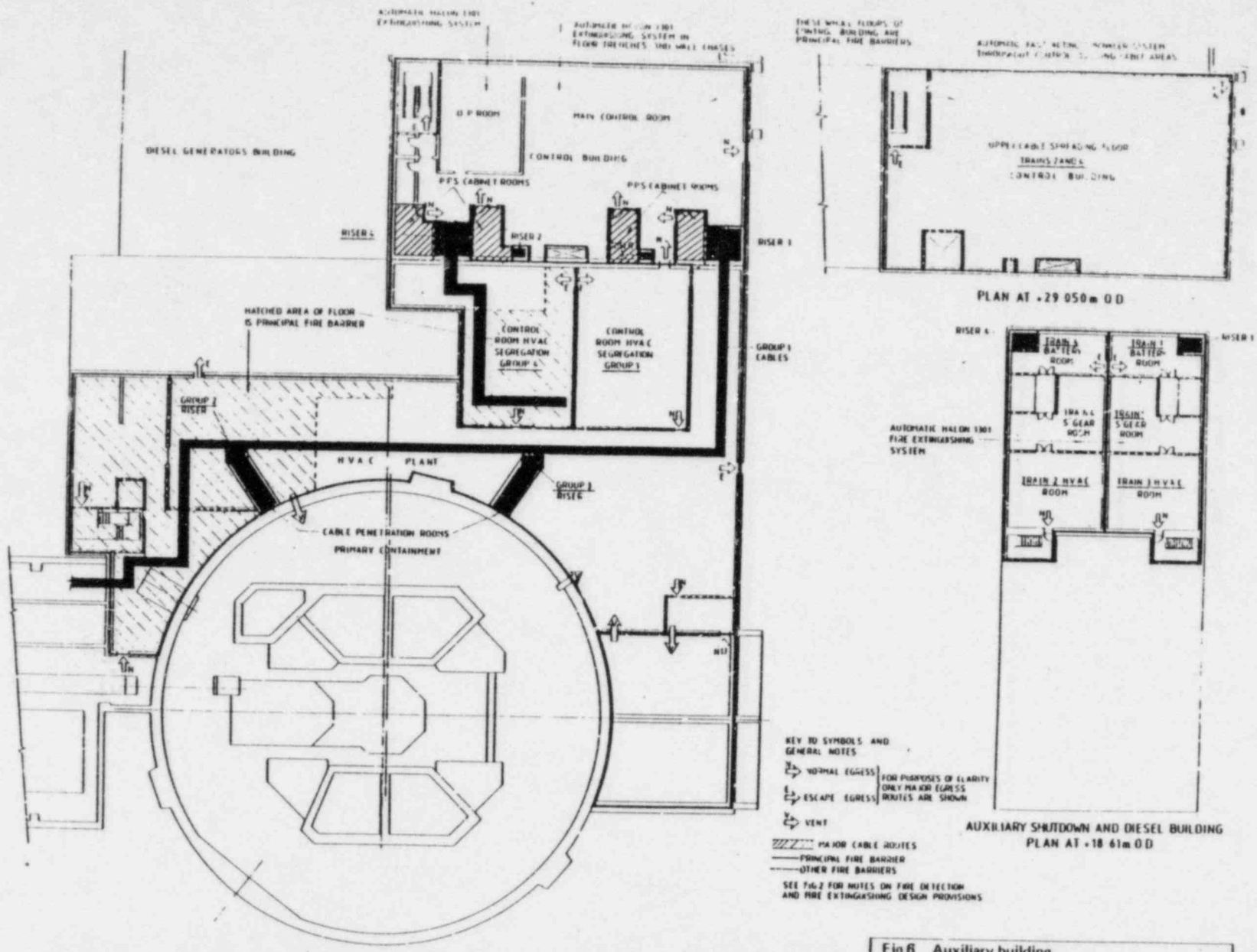


Fig 6 Auxiliary building
Arrangement of cable segregation groups showing principal fire barriers and their penetrations