02/24/59

Frank K. Pittman, Director
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Harold L. Price, Director
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PRELIMINARY DRAFT OF PROPOSED SITE CRITERIA

Attention: Joseph A. Lieberman

Transmitted herewith for your use is a copy of a Preliminary Draft of Proposed Site Criteria prepared by the Division of Licensing and Regulation.

Enclosure:
Preliminary Draft of Proposed
Site Criteria

OFFICE ▶	HEB:DL&R	HEB:DL&R	DL&R			
SURNAME ▶	JFNewell;jwl	CKBeck	HLPrice			
DATE ▶	2/24/59	2/ /59	2/2 /59			

Form AEC-318 (Rev. 9-53) U. S. GOVERNMENT PRINTING OFFICE 16—62761-3

A/42

Charles L. Dunham, Director
Division of Biology and Medicine

Harold L. Price, Director
Division of Licensing and Regulation

PRELIMINARY DRAFT OF PROPOSED SITE CRITERIA

Attention: Forrest Western

Transmitted herewith for your use is a copy of a Preliminary Draft of Proposed Site Criteria prepared by the Division of Licensing and Regulation.

Enclosure:
Preliminary Draft of Proposed
Site Criteria

OGM-7ACRS

OFFICE ▶	HEB:DL&R	HEB:DL&R	DL&R			
SURNAME ▶	JFNewell;jwl	CKBeck	HLPrice			
DATE ▶	2/24/59	2/ /59	2/24/59			

Form AEC-318 (Rev. 9-53)

U. S. GOVERNMENT PRINTING OFFICE 16—62761-3

To: C. R. McCullough, Chairman, ACRS

FROM: R. H. Graham, Tech. Sec., ACRS

SUBJECT: Comments on Draft "Standards for Permits and Liscenses 50:50 Site Evaluation Standards

The subject document was considered by paragraph. Numbers of members (ten present) requesting modifications of these paragraphs are listed below:

Paragraph	Members requesting review. Comments credible accident undefined	
1	5	
2	0	
2 a	0	
2 b	10	Five object to 25 R
3	6	
4 a, b, c	0	
4 d	6	
4 lower a b c	5	
5	0	
5 a	10	
5 b	0	
5 c	7	
5 (1) & (2)	5	approach unsatisfactory, too conservative
6	5	more justification
7	0	
8	4	

CC Osborne
Gifford
Silverman
J. B. Graham

File

ORM-7ACRS
XOIB-2-2

To: C. R. McCullough, Chairman, ACRS

From: R. H. Graham, Tech. Sec., ACRS

SUBJECT: Comments on DL&R Containment Regulation Draft

Below is listed the vote of the committee with ten members present by paragraph on the subject draft.

1 a	0
1 b	4
1 c	0
2	3
3 a	5
b	3
c	5
d	0
3 e	7
f	4
g	4
4 a	2
b	6
5 a	3
b	0

CC Osborne
Gifford
Silverman
J. R. Graham

Dr-ft
CKBeck

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STANDARDS FOR PERMITS AND LICENSES

50.50 Site Evaluation Standards

1. A Site for a proposed nuclear facility will be approved if there is reasonable assurance that the potential radioactive effluents therefrom, as a result of normal operation or the occurrence of any credible accident, will not create undue hazard to the health and safety of the public.

2. For the purposes of site evaluation, analysis at subsequent stages of the hazards which could arise from operation of the reactor, and evaluation of the acceptability of design, the following are defined as acceptable goals in the control of radiation and radiation exposures in areas beyond the site boundary:

(a) In routine effluents from normal operation of the facility, the radioactivity released must not result in levels beyond the site boundary in excess of the maximum permissible levels for continuous exposures. The levels are described in Part 20 of the Commission's regulations.

(b) From accidents which have a credible possibility of occurence, the radioactivity which would be released even under pessimistic dispersion conditions must not result in doses beyond the site boundary in excess of the permissible emergency dose. For the purposes in this regulation this will be taken as 25 r whole body radiation or its equivalent.

3. It is not reasonable to establish rigid, quantitative specifications which must be satisfied for a site to be approved. The wide possible variation in reactor characteristics and protective aspects of facilities can often affect the characteristics which otherwise might be required of the site. However, the following criteria have generally been applied, and will be utilized by the Commission as guides to the minimum requirements in site evaluation. The possibility is not excluded of deviating somewhat from these minima, in the direction of either more or less restrictive specifications, if particular features of any facility should so dictate. Where less restrictive specifications are proposed, the burden of proof of sufficient safeguards for public protection will be on the

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applicant.

4. Exclusion distance around power reactors.

Several reasons can be identified which indicate the desirability of an exclusion area around a reactor under the complete control of the reactor owner.

(a) The movement of any persons present in this area can be controlled by the applicant and hence exposure hazards in case of accident can be minimized.

(b) In case of contained radioactivity release (within the reactor facility), direct radiation to persons outside the applicant's premises is minimized.

(c) In case of small radioactivity releases to the atmosphere, intentional or otherwise, the exclusion zone assures some dilution before the radioactivity reaches public areas.

(d) In case of major releases under the majority of atmospheric conditions, an exclusion zone affords some period of time in which residents outside the area can be warned of the approaching hazards.

The following general guide is established to the size of the exclusion zone required:

(a) for power reactor up to 100 MWT = $\frac{1}{4}$ mile radius.

(b) for power reactor from 100 to 500 MWT = $\frac{1}{2}$ mile radius.

(c) for power reactors above 500 MWT = 1 mile radius.

5. Population density in surrounding areas.

In normal practice, power reactors have been so located that the population density in surrounding areas, outside the exclusion zone, is small. Several reasons in support of this practice can be cited:

(a) In case of catastrophe, a low population density assures that serious exposure of people is minimized.

(b) In case of catastrophe, relatively few people might be evacuated without injury, while large numbers of people could not be evacuated.

(c) In case of catastrophe, the economic value of property contaminated would tend to be less for areas of low population density than for areas of high population density.

In general, the following guide will be used in evaluating the suitability of population densities near reactor sites:

(1) To the distances stated below, the average population density should not exceed 40/sq. mile.

(2) To the distances stated below, there should be no population centers in excess of 6000.

for power reactors up to 100 MW, the distance involved is 10 miles

for power reactors from 100 MW to 500 MW, the distance involved is 15 miles.

for power reactors above 500 MW, the distance involved is 20 miles.

6. No population center in excess of 25,000 within 30 miles of a power reactor should be in the direction of the prevailing winds (more than 1/3 of the time).

7. If the site is in a region noted for tornados, hurricanes, or earthquakes, the design of the reactor must include safeguards which would prevent major radioactivity releases should these events occur.

8. The design of the reactor facility must include sufficient safeguards to prevent accidental contamination of any portable water sources or underground water streams by either liquid effluents or fallout depositions on the watershed.

Draft
Beck/cse
12/31/58

CRITERIA FOR CONTROL RODS

In a thermal reactor employing a usual control rod system, the following general principles apply:

1. Reliance for safety and control should not rest on one rod only.

2. Each single rod should have a limited value of reactivity, usually not more than 3 or 4% delta k.

3. The rate of reactivity addition by rod movement should be limited; 10^{-5} to 10^{-4} delta k/sec is customary.

4. The total amount of reactivity capable of being added by the automatic control system independently of normal action of the operator, should be limited to values not substantially larger than Beta.

5. The maximum value of any single rod, the value of the regulating rod, the permissible rate of manual and automatic reactivity addition, and the speed of response of the emergency scram system, must be related to the inherent shutdown characteristics and the speed of the transient behavior of the reactor.

6. Rod withdrawal schedules and sequences necessary to safety should be insured by design features and interlocks, not left to administrative instructions and procedures.

7. Switches for manual rod withdrawal should be spring-loaded to open; i.e., requiring operation of continuous operator effort during rod withdrawal.

8. At least some of the rods, representing sufficient reactivity capacity for shutdown, must be provided with mechanisms and devices which will achieve rapid insertion in case of emergencies. The response times of these devices should be related to the potential inadvertent delta k insertions.

9. There should be some dependable back-up mechanism in addition to the primary rod insertion device to assist rod insertion in emergencies, e.g., gravity, springs, pneumatic pressure, etc.

10. There should be provided adequate shut-down capacity; e.g., never less than 4% delta k below critical.

11. The power level of the reactor should be continuously indicated

on appropriate instruments during operation <u>and</u> during shutdown when any manipulations whatever on the reactor are in progress.

12. Attention must be given to:

    (a) Positioning channels or guides which insure reproducibility of location but provides freedom of movement, particularly during scrams.

    (b) Mechanical adequacy of rod structures.

    (c) Thermal stresses and distortions of rods.

    (d) Corrosion or solubility of rod components.

    (e) Buoyancy or flow effects of coolant or moderator.

    (f) Nuclear burning of rod poison.

    (g) Radiation damage in rod materials.

DR. BECK

EXTERNAL CONTAINMENT BUILDINGS FOR REACTOR FACILITIES

1. An external containment building is provided to enclose a reactor facility when the following conditions apply:

   (a) There is a credible possibility that radioactive materials having airborne potentiality could be released from the reactor assembly.

   (b) The quantity of such released material could be sufficiently large that its dispersal under pessimistic atmospheric conditions could give exposures to individuals beyond the site boundaries in excess of permissible emergency doses.

   (c) The number of people and their distribution in the areas beyond the site boundary which could receive exposure doses are such that their immediate evacuation in case of reactor accident would be difficult to accomplish or unreasonable to require.

2. Where external containment vessels are required, one of three general types of conceptual plans is used, depending on circumstances and requirements in particular situation: 1) a "high integrity," "absolute" containment vessel, 2) a partial containment supplemented by controlled, purified release and 3) a time-sequenced, pressure-relieving, 4) reactivity-retaining vessel for cases where pressure buildup and reactivity release do not occur simultaneously.

3. Characteristics and use of "high integrity" containment vessels:

   (a) These vessels are used when radioactivity release, usually though not necessarily accompanied by pressure buildup, may occur and it is necessary to retain the radioactivity.

   (b) The vessel must be built to withstand with sufficient safety margin pressures as high as any that it may be necessary to contain. If the vessel is of metal, its design and construction should be carried out in accordance with the applicable sections of the ASME Unfired Pressure Vessel Code, with special attention given to components or features to which the Code does not apply. The design pressure of a vessel built to Code requirements may be chosen as 1/2 of the maximum pressure expected to occur from any credible accident (thus vessel failure would be expected only at pressures of double the maximum pressure expected); and the maximum test pressure to which the vessel is subjected should be equal to the maximum pressure ever expected.

(c) The permissible leak rate to be specified for the vessel and to be verified by tests before reactor startup and at specified intervals thereafter, must not exceed that which would result in exposures to people beyond the site boundary in excess of the permissible emergency doses in the event that the worst credible reactivity release accompained by the largest pressure buildup inside the vessel should occur under pessimistic conditions of atmospheric dispersal.

(d) If leak tests are carried out at one pressure, the calculations of volume leakage at a higher pressure shall be based on a $P^{\frac{1}{2}}$ relationship between volume flow and pressure; not on a linear relationship.

(e) Where accidents with the reactor could cause the generation of shockwaves on projectiles, sufficient protection against these must be provided to insure that the vessel will not be breached thereby.

ventilation ducts or other conduits which are normally open to the outside or could be opened by accident, these penetrations must be provided with automatic valves which would close in sufficient time after an accident to prevent escape of radio-activity released inside the vessel.

(g) The requisite pressure capacity and leakage specifications must be maintained at all times the reactor is in active status.

4. Use of "Controlled Release" Containment Vessels:

(a) Semi-tight buildings, equipped with means for controlled exhaust through suitable filters, scrubbers, etc. to maintain reduced internal pressure and thus prevent outleakage through holes and cracks, may be used where reactor characteristics and location are suitable. This concept is most applicable where potential accidents would build up little or no pressure, hence would not damage the exhaust purification devices and would not require excessive air release to reduce internal pressures below ambient, and where the location is such that gaseous effluent not easily collectible in purification systems could be released to the atmosphere without potential hazard to large number of people.

(b) The maximum radioactive effluent from this facility considered to be credible must not present a potential threat of exposure of people beyond the site boundary to doses in excess of the permissible maximum dose.

5. The separated pressure - radioactivity release concept:

(a) This containment plan may be used for reactor facilities in which it can be shown that release of radioactivity would follow by a definite time interval, not precede or accompany, any pressure surge which might arise inside the containment vessel. The plan then is to leave the containment open, or allow it to open automatically, until any pressure surge has been exhausted, to be followed by secure automatic closing of the openings for retention of any radioactivity subsequently released.

(b) The containment vessel would, by this plan, be a "high integrity" vessel (3 above), but its pressure capacity would only need to match the requirements of the post-pressure situation; not the maximum pressure buildup.

Draft
/Beck/cse
12/29/58

CONTROL SYSTEMS

1. There must be instruments, equipped with automatic level and rate of rise trips, capable of responding to the neutron flux in the start-up range.

2. There must never be less than 2, preferably 3, independent flux monitoring channels.

3. If normal instruments at any range are all similar, it is desirable that these be backed up by a scramming mechanism of another type.

4. On reactors having power levels of 1 Mw or less, both flux level and period scram protection must be employed at all times.

5. On reactors above 1 Mw, flux level scram protection must be employed at all levels. Period scram is not mandatory in the operating range.

6. Arrangement for a scram only on trip coincidence from 2 channels may only be employed if there are at least three independent channels from which the coincidence trips can originate.

7. During start-up or operation at levels substantially below nominal maximum power, at least one level scram (neutron, gamma, temperature) must ride down in the near vicinity of actual level at any time, and be advanced as necessary as the power increases.

8. There must be periodic check by appropriate signal input or mock up source of the actual response of each safety channel over the whole response range, including activation of the alarm, trip or scram device.

9. Insofar as possible all safety channels must be so constructed that their failure will cause shutdown.

Continued.

10. In any flux detector there must be an interlock which will cause reactor scram if the high voltage supply to the chamber deviates substantially from the proper value.

11. Interlocks of all sorts should be chosen with great care. It is essential that the necessary ones be provided, but it is hazardous to provide more than are needed. Once chosen, a safety interlock must never be by-passed or deactivated by the operating staff.

12. Safety interlocks must be so arranged that range changes of indicators do not deactivate or move the position of the alarm, trip, or scram point.

13. After any maintenance or alteration of a safety channel, a complete recheck of response must be made, including interlock activation by an appropriate impressed signal.

14. An automatic power level control system may not have capability of both a rapid delta k insertion and a large delta k insertion. In any case, the excess reactivity which may be inserted automatically may not exceed the equivalent value of (beta) except in special circumstances.

15. When an automatically operated control rod of appropriate value reaches its limit of travel it may not automatically invoke shim withdrawal.