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METROPOLITAN SITING — A HISTORICAL PERSPECTIVE

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U. S. NUCLEAR REGULATORY COMMISSION

REQUEST FOR COMMENTS ON NUREG DOCUMENT

METROPOLITAN SITING - A HISTORICAL PERSPECTIVE

The Nuclear Regulatory Commission has issued a report in its NUREG series. This series presents technical information gathered by the staff or its contractors and consultants on subjects related to the activities of the Nuclear Regulatory Commission and to its responsibilities.

The issued draft, NUREG-0478, "Metropolitan Siting - A Historical Perspective" discusses the development and implementation of the staff's practices in the review of densely populated sites. The information has been developed to help clarify the bases for the staff's current practices, and to provide a resource base for future staff reviews in this area.

Comments and suggestions in connection with the use of this information or the content of the document are encouraged at any time. Public comment on this issuance, if received by January 31, 1979, will be particularly useful in preparing a revised NUREG document for Commission consideration.

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Dated at Bethesda, Maryland, this 25th day of September, 1978.

FOR THE NUCLEAR REGULATORY COMMISSION

Harold R. Denton

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METROPOLITAN SITING - A HISTORICAL PERSPECTIVE

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Introduction

With the Atomic Energy Act of 1946, the nation embarked on a R&D program that would ultimately lead to the use of nuclear fission processes to generate electrical energy. Recognizing the potential hazards involved in the handling of nuclear materials, the location of production and test reactors was a matter of some concern. Generally these facilities were located in isolated areas of the country. Site isolation was judged as a key means of assuring low risk to the public from possible accidents at these reactors.

As an aid in the site selection process, a calculational model was developed that related the size of the reactor to desired exclusion distances. This formula (distance in miles = $0.01 \sqrt{\text{kwt}}$) was related to perceived consequences of a major accident and was thought to provide a sufficient buffer zone so that even the most severe accident would not have catastrophic consequences, simply by requiring inherent protection through selection of sites remote from cities or large centers of population (1). As more and more facilities were designed, the philosophy of requiring very remote siting by the buffer zone approach began to be regarded as excessively burdensome. If the same rule of thumb used in the siting of these first reactors were to be continued, new facilities would either have to be located in areas well away from most regions of the country, or large amounts of land would have to be purchased to provide the necessary buffer zone between the reactor and the surrounding population.

With the establishment, as a national goal, of a program to developing peaceful uses of atomic energy (formalized with the 1954 Amendments to the Act) additional reasons to reconsider the approach of requiring very remote sites came into being. To accomplish the policy towards peaceful uses of nuclear energy, broad participation on the part of the utility industry was necessary. If nuclear reactors were to be practical they needed to be located reasonable distances to the load centers they would serve. This requirement provided further impetus for a new policy for siting reactors; the utility preference for locating central station power reactors close to load centers required that the agency balance its desires for site isolation against the needs of the utility industry.

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* This paper is based on the author's reviews of policy statements and analyses of the NRC and AEC on this subject. The conclusions presented herein are strictly and solely those of the author

The accommodation of these opposing concerns was to increase the degree of reliance on containment and relax, somewhat, the degree of site isolation that would otherwise be required. The agency's ultimate resolution of this issue was formalized in the Reactor Site Criteria (Part 100) in which provisions were made to keep central station power reactors "a reasonable distance" from densely populated centers.

While the general premise of the criteria in Part 100 was to strike a balance between site isolation and proximity to load centers, flexibility was deliberately written into the guides. The Commission's avowed purpose was to set forth interim criteria which were written in such a way that they could be administered in an evolutionary manner. (2)

As of 1978, 25 years after the first announcement of the first facility involving utility ownership and participation, Shippingport, the AEC and its successor, the NRC, had received and reviewed information on over 200 reactor sites. The "interim" guides issued in 1962 have yet to be replaced, and the staff's Part 100 reviews display a diversity of postures that has been possible only by the general language of the siting criteria.

It is the purpose of this paper to discuss the development and implementation of the Reactor Site Criteria and particularly the evolving posture of the agency on the subject of metropolitan siting. The review actions on nine sites are described to illustrate the various issues and positions and to clarify at least some of the bases for the staff's current practices.

Shippingport

As a result of a variety of technical and political developments, the Atomic Energy Commission invited, in late 1953, proposals by utilities to construct a pressurized water reactor (see Reference 3 for a discussion of the events leading to this decision). The proposal by Duquesne Light Company was selected, with the reactor to be located on a company-owned site along the Ohio River at Shippingport, Pennsylvania.

In the preceding years, location of production and research reactors had been reviewed by advisory committees of the AEC, and the prevailing philosophy was to require location of such facilities in isolated areas. While each facility was reviewed on its own merits, a rule of thumb guideline was also developed to assist in the reviews. One such guideline, developed by the Reactor Safeguards Committee, was formula relating distance to cities and reactor power. This formula, having been developed for first-generation projects, required considerable separation from cities (Reference 1). Even before the Duquesne proposal was accepted, the utility of this approach to power reactors was being questioned because the land required to achieve the necessary separation could be prohibitive even for test reactors. Secondly, many viewed the earlier philosophy of isolation as being impractical for central station power reactors, because of the need to be close to load centers.

In the case of the Duquesne proposal, the 420-acre site was roughly 20 miles from Pittsburgh, and generally in an area more heavily populated than the sites of earlier production and test reactors (see Table I for a tabulation of the population surrounding this and the other sites discussed in the paper). The decision leading to the selection of the Duquesne proposal stemmed from factors other than site isolation (such as the need to maintain a lead in the field of nuclear energy by capitalizing on the recent success of the PWR developed for the Navy, the need to find an able and willing utility, etc.). In fact, it is not apparent that any special consideration was given to site isolation in the selection process.

During the period of construction of the Shippingport reactor, Senator Bourke B. Hickenlooper wrote the ACRS (Reference 4), noting that the facility was located in a "densely populated area" and questioned whether reactors should be located in areas of very low population density (as was the case in the earlier, AEC-owned facilities). That letter prompted an answer by AEC Chairman W. F. Libby (Reference 5) who articulated the principle of defense-in-depth that was to be applied to the design of new reactors and expressed the policy that "power reactors.... will rely more upon the philosophy of containment than isolation as a means of protecting the public against the consequence of an improbable accident, but in each case there will be a reasonable distance between the reactor and major centers of population." (The exchange of correspondence is included as Appendix A).

This view of balancing containment and site isolation signaled a major turning point in the site reviews of the agency. Henceforth, the philosophy of containment (as opposed to reliance on isolation) was to have a profound impact on the siting decisions of the agency.

An elaboration of this view also surfaced in later reviews of Shippingport. In 1960, the AEC regulatory staff undertook a review of a proposed increase in power level of the Shippingport reactor (to 505 MWt). During that review the regulatory staff advised the development staff that "the relatively high close-in population density at the Shippingport site will require greater than usual reliance to be placed on the engineering safeguard features of the facility..." (6). This philosophy of special compensatory measures at densely populated sites was to be reflected in Part 100 and in staff practice during the early 1960s. [A vestige of this policy of special compensatory measures still exists in the general language of the Introduction to Appendix A to 10 CFR Part 50 and specific language of GDC 55 (7).]

Indian Point

The Consolidated Edison Company of New York, Inc. submitted, on March 22, 1955, an application to the AEC for a license to construct and operate a pressurized water thorium-uranium converter reactor capable of producing 500 MWt. The reactor was to be located at Indian Point on the Hudson River about 24 miles north of the corporate boundaries of New York City and two miles southwest of Peekskill, New York. It appeared from the application that there were approximately 45,000 inhabitants within a five-mile radius around the site and that about half of these inhabitants lived in Peekskill. There were no residences or industrial plants within 1/4 mile. There were 16 one family residences and no industrial plants within 1/2 mile.

The staff concluded that the construction and operation of the proposed reactor would contribute materially to the demonstration of practical value of the pressurized water-type reactor, that the basic concept was sound, and that the applicant had obtained highly competent assistance. Using the information on the site in conjunction with the technical information which has been submitted on the reactor and its containment, the staff, with the advice and assistance of the ACRS, concluded that the design approach to the reactor was sound and saw no hazards problems which appeared insoluble.

Taking all consideration into account it was concluded by the staff that there was no reason to believe that a reactor having the general characteristics and specifications indicated could not be constructed and operated at the proposed site without undue risk to the health and safety of the public (8). In this case, the utility's service area was greater metropolitan New York, the largest center of population in the United States. The staff did consider the hazards associated with accidental releases of radioactivity but since the application contained, generally, only statements of philosophy and design criteria, the reviews were limited in scope.

As in the case of Shippingport, little emphasis was given to the review of the site, other than to note the degree of site isolation. That the site review could be so limited apparently stemmed from a perception that the burden of proof rested on the final hazards report, such that any site-related problems that surfaced would have to be accommodated by design before the plants were allowed to operate.

It is not clear if any consideration was given to the total population, other than recognition of the distance to New York City, using again the philosophy expressed in the Libby letter.

Another significant aspect of the Indian Point site is the subsequent placement of two additional and much larger reactors at the same site some years later. The AEC regulatory staff had published, in 1961, a procedural formula for siting power reactors, as part of a for-comment version of 10 CFR Part 100 (9). That formula related required distances to cities to reactor power level, but did not include consideration of population density (see Reference 10 for a discussion of the rationale for the criteria). The question arose during the period of comment on Part 100 (before application for the second and third units had been made), and arguments were made to modify Part 100 to, permit more than one reactor at a single site (which had not occurred to that time). Language was subsequently included in the 1962 version to this effect (11).

During the years following issuance of the CP for Indian Point Unit 1, a number of major decisions were made, and reconsidered, on the philosophy of siting in densely populated areas. One determination that was made was that the total population in the vicinity of a reactor was an important factor, perhaps as important as the degree of separation from large cities. In this context the Indian Point site was, and is, one of the less favorable sites. As shown in Table I, the total population surrounding the Indian Point site is larger than that of any other site approved for a nuclear power reactor.

When in late 1965, Consolidated Edison submitted an application for a second unit at the site, the staff policy of requiring special compensatory features at densely populated sites was still in vogue; the site criteria had been issued as regulations and (as will be discussed) the agency had just been involved in a test of its siting philosophy in reviews of two metropolitan sites (one of which was a Con Ed application). Unit 2 was approved. In this review, the central question was not whether the site was suitably isolated but what features were necessary to engineer the second unit so that it was acceptable at that site. There appears to have been little consideration to alternative sites or to the incremental risks posed by multi-unit stations.

An application for a third unit was submitted and accepted. From this point on, the staff apparently accepted, without question, the location of additional units at a site.*

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* Note, in a very recent action on Pilgrim Unit 2, a licensing board has challenged this practice and the staff has been required to consider sites other than at Pilgrim, as part of the NEPA reviews. No challenge has been made to the acceptability of multi-unit siting in the safety reviews.

Jamestown

In 1959, after about a year of development effort, the AEC issued proposed general site criteria for public comment. This followed the reviews of a number of applications (Indian Point, Haddam Neck, San Onofre, Dresden) which were all located some distance from large cities. The draft criteria (Reference 12) recommended that "It is usually desirable that the reactor should be several miles distant from the nearest town or city and for large reactors a minimum of 10 to 20 miles distant from large cities."

In late 1959, it was proposed that a 60 MWt PWR be located in Jamestown, New York. This proposal, sponsored by the AEC's developmental side, was to be another of the demonstration reactor programs. The location of even a small reactor in a city again emphasized the basic conflict between utility preferences for locating close to load centers and staff desires for inherent isolation, as discussed in the Libby letter on Shippingport.

This proposal was not received favorably by the Regulatory staff. A representative statement of the staff's view was provided in the ACRS letter on this project (Reference 13):

> "The Committee deplores the tendency on the part of some of those proposing reactor sites to place power reactors containing large quantities of stored energy in or near centers of population at this time to duplicate conditions for conventional power plants for the sake of demonstrating how near a population center such a reactor can be located. We believe that the Jamestown reactor is a case of this kind. We wish to point out that the proximity to a population center will require more rigid specifications of all safety features including containment, leakage rates, power densities, ultimate power, shielding, etc. Thus, it appears that the improved economies of shorter transmission lines may be far outweighed by the increased costs of safety features and more conservative operations. In addition, this reactor will require most stringent surveillance by the AEC during its entire life adding expenses to both the user and the Government."

In this same letter the ACRS also summarized its position on the balancing of containment versus isolation remarking that: "...the Committee doubts that the new and relatively untried technical features for improved safety proposed by the application...are a satisfactory substitute for the inherent safety implied by a greater distance from population centers."

The 1961 version of the draft siting criteria embodied this philosophy. After extensive comment, on this draft much of which again criticized the philosophy of isolated siting, the Commission issued general siting criteria, as 10 CFR Part 100. The criteria were substantially the same as the 1961 version, and embraced the same policy of keeping reactors away from densely populated areas. However, a more moderate tone was suggested as to the continued application of this policy. It was emphasized that the criteria were of an interim nature and that "It should be understood, however, that applicants are free and indeed encouraged to demonstrate to the Commission the applicability and significance of considerations other than those set forth in the guides" (Reference 14).

Thus, the regulations appeared to reflect a changed posture in the Commission's policy towards metropolitan siting, one which held out the promise for continued evolution to metropolitan sites (rather than a permanent maintenance of the policy of keeping reactors a reasonable distance from cities).

Ravenswood

On December 10, 1962, nine months after the Commission's new regulation was issued, the Consolidated Edison Company of New York, Inc. submitted an application to construct a 2850 MWt generating unit (2030 MWt nuclear, the remainder from oil-fired superheaters). The site was to be located on Long Island in the Borough of Queens. At 1000 MWe, the project was twice the size of any previously authorized power reactor.

Judging from the press release on this application (Reference 15), the industry was ready to take advantage of the possibilities for "special considerations" advanced in the new rule. The value of proximity to load centers was identified as was a number of other advantages such as the "safety advantages" associated with the dilution characteristics of the East River. The press release noted that "although daytime population within a five mile radius of the site exceeds five million, the plant has been designed to limit all direct radiation and all radioactive discharges. In addition to additional features not found in earlier applications to prevent accidents, a special dual containment was included to prevent the escape of any accidental release.

Thus, the basic premise of this application was full reliance on engineered safety features as a substitute for site isolation. Adverse public reaction surfaced, basically expressing the concern that was central to the implied policy in Part 100, namely that since no reactor is fool proof, the possibility of accident cannot be completely eliminated. Hearings were scheduled on a proposed city ordinance prohibiting nuclear reactors in the city.

The agency made no immediate decision on the merits of the proposal; instead the staff began the process of reviewing the various safety features included in the application with a view towards examining how effective the ESF's could be expected to be and then compare this determination with a judgment of how effective they needed to be.

The review of this application, and the attendant concern expressed by people in New York, did result in one major development. When Part 100 was issued, there was reference made to a document, TID-14844, which contained an evaluation procedure, which was suggested as providing an aid in deriving the required distance to population centers (16). This aid produced distances which were generally compatible with past siting decisions. The formula in TID-14844 would have resulted in a required distance to a city of over 20 miles for the Ravenswood design.

The proposed location in the midst of a heavily populated area, and the proposed power level well in excess of that in any similar reactor previously built, raised to an unprecedented degree the issues of confidence that could be placed in the dependability of engineered safeguards at the then existing and proposed level of development. The staff appeared willing to consider the case on its merits (and possibly accept a site whose location appeared to run directly counter to the general policy expressed in the criteria of Part 100 and TID-14844). Nonetheless, the questions that required resolution were formidable.

On December 3, 1963, the Regulatory staff wrote to the applicant on this matter stating:

> "Your application is the first to propose construction of a nuclear power reactor in a densely populated urban area. Heretofore, all applicants have relied upon a combination of engineered safeguards and distance from highly populated areas to protect the public from the consequences of a serious reactor accident. Since your application is the first to propose reliance wholly upon engineered safeguards for this purpose, it presents substantial question as to the application of Commission policy for the siting of nuclear power reactors."

And, referring to the staff's reviews,

> "It has seemed possible that, upon completion of this analysis, the regulatory staff and the ACRS would be able to reach a position on the basic siting question" (17).

On January 3, 1964, Consolidated Edison announced that it was withdrawing the application. The reason given was that other means existed to meet the immediate needs for additional generating capacity (18).

After the review of this application began the staff began to issue statements that signaled that TID-14844 was to be followed in the breach and not in the letter. One staff opinion was that the suitability of a site for any particular reactor cannot be determined from the guides in Part 100 simply by calculations or any rule of thumb (Reference 19, included herein as Appendix B).

There had been three applications submitted soon after Ravenswood; in each case sites were approved with less distance requirements than would have been otherwise been required by the TID formula had not certain safeguard systems been incorporated into their design (San Onofre, Malibu, Haddam Neck). From this point on, the distances to cities that were calculated in TID-14844 had no real value.

Boston Edgar

On January 8, 1965, a year after the Ravenswood application was withdrawn, representatives of the Boston Edison Company met with the Commission to discuss a tentative proposal to construct a 600 MWe nuclear power plant in the Metropolitan Boston area. The site preferred by the utility for the location of the nuclear power plant, its Edgar Station in Weymouth, was about 9 miles from the center of Boston. The two principal reasons cited for their strong preference for the Edgar Station site were: (1) absence of zoning and land acquisition problems; and (2) availability of transmission lines without extensive new construction. No other site appeared to offer these advantages.

The immediate reaction of the Regulatory Staff (whose views may have crystallized as a result of the Ravenswood case) was that power reactor technology and experience with advanced safeguards had not yet reached the stage where it could be considered prudent to permit the construction and operation of nuclear power plants in densely populated areas of major cities. However the conflict between utility preferences and staff preferences soon took on the dimension of internal staff disagreements, with the developmental side of the agency (as in the case of Jamestown) advocating a position contrary to that of the regulatory staff. The ACRS suggested that a flexible position be taken with respect to locating reactors close to cities should be maintained and that a suitable channel for the early consideration of new facility concepts (ones which employed improved provisions for safety) should continue to be available.

Following discussions by the various parties, the Commission approved on June 18, 1965, a statement regarding activities related to reactor safety (this statement was read into the record of the hearings on the Price-Anderson Act and is included herein as Appendix C and Reference 20). In substance, the ACRS view was adopted. Boston Edison was advised of the position that further operating experience and additional R & D, together with increased emphasis on the development of improved reactor standards would be necessary before an application such as proposed could be approved. The developmental and regulatory staffs were directed to augment programs under their respective jurisdiction (e.g., an accelerated and redirected R & D program, increased emphasis on standards and criteria) so as to permit, at some future date, the opportunity for metropolitan siting.

The interim policy articulated was thus that the Part 100 words regarding "appropriate and adequate compensating engineered safeguards" meant <u>some</u> reduction in the isolation distance, but only some. The general perception was that a reappraisal of this policy could not begin until some time after 1971.

<u>Burlington</u>

On December 13, 1966 an application was submitted for construction of a reactor at a site located on the east bank of the Delaware River estuary, adjacent to the City of Burlington, New Jersey. It was approximately seventeen miles northeast of downtown Philadelphia and eleven miles southwest of Trenton, New Jersey. The reactor design was similar to that of Indian Point Unit No. 3 (stretch power 3217 MWt), for which a formal application was submitted in April 1967.

While the population was lower than that of Boston Edgar it was still 2-6 times that of Indian Point (out to a distance of 15 miles). Beyond 15 miles it was greater than that of Boston Edgar.

Considerable effort was spent by the staff on evaluating the significance of the size of the population (including projected population growth) and on the ability of (and reliability of) engineered safety features provided to mitigate the consequences of accidents. The staff and ACRS's perception, again, was that the proposal basically involved a confrontation on the matter of metropolitan siting. After discussions with the licensing staff and the ACRS, the applicant decided to relocate its proposed nuclear plant at some site other than Burlington (the new site was Salem).

Part of the aftermath of the review of this application was an exchange of correspondence between the AEC and the Governor of the State of New Jersey. The AEC restated and expanded upon the policy that was announced in 1965 (the AEC letter, Reference 21, is included as Appendix D).

The 1965 view was basically that satisfactory operating experience and successful R & D was needed and that improved safety systems should be available for use in metropolitan sites. Later, the general statement advancing a temporary "prohibition" against metropolitan siting was further extended. This was subsequently interpreted to apply to sites of somewhat greater population density than that of the Indian Point - Zion type of site (e.g., approximating that of the Burlington site). In other words no more sites, for the time being, more densely populated than at Indian Point. A corollary position, of equal significance,was that sites as densely populated as Indian Point could be made acceptable using contemporary designs.

Newbold Island

By letter dated May 6, 1969, the Public Service Electric and Gas Company requested an informal review of their proposed Newbold Island site by the regulatory staff and the ACRS. The site was 4-1/2 miles south of Trenton, N.J. and 11 miles northeast of Philadelphia. The nearest population center was collectively known as Levittown, whose nearest boundary was 3.4 miles WNW of the site. The projected population about Newbold Island significantly exceeded that of Indian Point beyond five miles; beyond 34 miles it was less than at Indian Point.

The staff noted during its site review that, unlike Indian Point, the population was not centered in one direction and thus the probability of a plume from the plant crossing a densely populated area was higher at Newbold Island. The ACRS concluded that "the Newbold Island site is not unacceptable with respect to the health and safety of the public..." provided that special attention was paid to certain aspects of the design (22).

Shortly thereafter an application was submitted. In order to compensate for the size of the population surrounding the site, features beyond those then incorporated in LWRs were to be used in the Newbold Island facility design (as suggested by the ACRS letter).

During the course of the review several complicating factors emerged. First, the National Environmental Policy Act (NEPA) was enacted. Secondly, it turned out that the availability of water supply was in question; a proposed dam (Tocks Island) was needed and there was considerable uncertainty as to whether the dam would be approved. Thirdly, it was found that plans existed to develop a sizable housing development relatively close to the site (a few miles). The staff and the ACRS continued to express the view that the site was a suitable site up to about August of 1973 (even if the proposed housing development were to be considered a population center within the meaning of Part 100).

Questions were raised by the licensing board regarding this housing developme (In subsequent discussions with officials at the site in October of 1973 it appeared that the development could be very close to the plant, possibly requiring that the Part 100 population center distance be set at about 1/2 mile). On October 5, 1973, the Regulatory Staff advised the utility that it (the AEC) was intending to set forth, in its forthcoming final environmental statement, a conclusion that an alternative site (Salem) was more desirable "from an environmental standpoint"; population density was stated as the principal factor leading to that conclusion (the letter, Reference 23, is included as Appendix E).

The applicant subsequently amended the application as to relocate the plant to that alternative site identified by the staff (the facility is now named Hope Creek). In subsequent correspondence (Reference 24), the staff stated its view that the Newbold Island site did not pose an unacceptable risk to the general public from a safety point of view.

<u>Bailly</u>

Northern Indiana Public Service Company filed an application dated August 27, 1970 to construct a 2028 MWt (stretch power) reactor on the Shore of Lake Michigan, 10 miles northeast of Gary, Indiana. This site was viewed as acceptable from the safety view point.

What is exceptional about this case is the controversy surrounding the alternative site review. The intervenors in this case had suggested that another site was preferable to the Bailly site, principally because of relative differences in population density. The staff argued that the risks associated with accidents was extremely low. The licensing board ruling on this was ".... Therefore, the Board concludes because of the improbability of a Class 9 accident with the concommitant risks, no significant weight can be given to the low population density surrounding the Schaffer site in its cost-benefit analysis" (25). This, of course, is directly counter to the staff's position advanced in Newbold Island.

Perryman

In 1973, the Baltimore Gas and Electric Company submitted for an acceptance review, an application to construct a power reactor at a site about 16 miles north of Baltimore, Maryland. Following closely on the heels of the Newbold Island reviews, during the time when the staff was attempting to institutionalize numerical population density limits, (26) the staff advised the utility to consider an alternate site.

By 1976, the proposed population density limits had been transferred into "trigger" values to be used in the NEPA reviews of alternative sites (Reference 27). Ostensibly they did not apply to the safety review and no mention was (or is now) made of any compensating engineered safety features needed if the trigger values are exceeded. All that was required was that

> "In these circumstances, the applicant should be requested to provide sufficient information on alternative sites to permit a preliminary balancing by the staff of significant environmental, economic, and other aspects of the alternative sites, including population distribution. If this preliminary balancing results in a determination that an alternative site with a significantly lower population density offers significant advantages from overall environmental impact and safety points of view, Regulatory management should be informed of this preliminary conclusion. For cases which just exceed or fall below these guidelines, an examination of the particular population distribution may be required in determining whether to implement these procedures." (Reference 28).

In 1977 BG&E resubmitted their application, this time limited to a request for a review of the site. The applicant's analyses indicated that the trigger values were exceeded but that even late in the life of the facility, the population was less than that at Indian Point.

The staff conducted a special alternative site review. For a variety of reasons, including the size of the population at Perryman relative to other sites, the staff concluded that the BG&E application should be denied (Reference 29). Although BG&E objected to a number of the arguments and conclusions in the staff's report, they withdrew their application before the matter was taken before the licensing board.

The staff's special alternative site review gave considerable attention to population factors, including the importance in differences in population density on the relative risks associated with Class 9 accidents at the various alternative sites. Although previous staff testimony (upheld by the Court Ruling) on Bailly indicated that residual or Class 9 accident risks need be given no significant weight in the alternative site review, the staff's report on Perryman took the opposite view. (In this instance, as opposed to Bailly, new information was available via the Reactor Safety Study, which indicated that, given the current staff requirements for acciden prevention and mitigation, Class 9 accidents dominated residual accident risks*).

Regardless of the merits of the staff's posture on Perryman, it represented yet another turning point in position. First, the staff arguments represente a substantially different position than in Bailly on the matter of the relevance of population density in the environmental reviews. Secondly, the staff attempted to clarify their views on the significance of the trigger values, with the thrust being that new sites should not be as densely populated as Indian Point unless there were other overriding reasons (environmental or economic). This position is starkly in contrast to the views of the 1960's where an evolutionary approach was maintained permitting, ostensibly, siting in ever more densely populated areas.

* Preliminary staff analyses indicated that residual accident risks, including Class 9 risks, were not a major environmental impact (Reference 30). A recent ruling by the Atomic Safety and Licensing Appeal Board (Reference 31), in connection with an unrelated case, can be interpreted to reverse the staff's position on Perryman. However, this case is still under review.

Summary Remarks

From the outset of the development of nuclear power reactors for use in central station generation of electricity, there has been a recognition of the need to achieve some sort of balance between isolation and proximity to load centers.

One of the central issues surrounding the review of sites has been the question of metropolitan sites, and whether (and where) reactors can be located in or close to metropolitan areas.

A number of "metropolitan" sites have been reviewed (Jamestown, Ravenswood, Boston Edgar, Burlington, Newbold Island); none have been approved. Reviews of these cases has resulted in relaxation in the requirements for site isolation from that recommended by the regulatory staff in the 1950's and early 1960's. Nonetheless, the promise of continued evolution (relaxation) in the siting criteria has not materialized. In fact, a review of the trend of sites approved (see Figures 18 and 19 of Reference 32, which are included here) shows that the average distance from reactors to population centers is increasing - not decreasing. The average population within a 30 mile radius of the reactors is also decreasing (from about 2 million for plants licensed in 1955/1956 to about 300,000 for plants licensed in 1975/1976).

The reasons for this trend are not obvious, and there have been many circumstances which have contributed to individual decision at various points in time. The early years were typified by an attitude favoring flexibility and an evolutionary approach. The decisions in the mid-1960's and early 1970's are traceable, in large measure, to the application of flexible, general criteria, and the ambiguity in policy that resulted (or appeared to result) from the review of a few cases.

The staff's recent practices appear to mark a further turning away from an evolutionary approach; emphasis on standardization, early site reviews and the regulatory delays associated with cases (designs and sites) outside the norm provide strong incentives to maintain the status quo.

It may well be that these latest developments will introduce a measure of predictability in identifying sites which are acceptable from a population standpoint. However, the current practices have not been made into regulations. It may well be that a new application for a densely populated site, or Commission action on cases currently under review, could once again cause a substantive shift in the perspectives on metropolitan siting.

<u>References</u>

1. "Atomic Energy Commission Reactor Exclusion Distance Formula, Report by the Director of Reactor Development", AEC 172/13, July 15, 1952. Available in NRC PDR for inspection and copying for a fee.

2. Letter, H. L. Price, Director of Regulation, U. S. Atomic Energy Commission, to Arthur C. Perry, Assistant to the Vice President, Office of the Vice President, April 24, 1963. Available in NRC PDR for inspection and copying for a fee.

3. Robert Perry et al., "Development and Commercialization of the Light Water Reactor, 1946-1976" Rand Corporation Report No. R-2180-NSF (June 1977).

4. Letter, Honorable Bourke B. Hickenlooper, Joint Committee on Atomic Energy, to Roger McCullough, Chairman, Advisory Committee on Reactor Safeguards, February 15, 1956. Available in NRC PDR for inspection and copying for a fee.

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25. 8 AEC 269, Atomic Safety and Licensing Appeal Board (at 624). Available for inspection in NRC PDR for inspection and copying for a fee.

26. "Population Distribution Around Nuclear Power Plant Sites", April 17, 1973 (Press Release T-160), United States Nuclear Regulatory Commission. Available in NRC PDR for inspection and copying for a fee.

27. "General Site Suitability Criteria for Nuclear Power Stations", Regulatory Guide 4.7, Office of Standards Development, United States Nuclear Regulatory Commission, November 1975. Available in NRC PDR for inspection and copying for a fee.

28. Memorandum, J. F. O'Leary to A. Giambusso and J. M. Hendrie, "Population Density Consideration in Acceptance Review of Nuclear Power Plant Applications", November 28, 1973. Available in NRC PDR for inspection and copying for a fee.

29. Letter Harold R. Denton U.S.N.R.C., to John W. Gore, Jr., Baltimore Gas and Electric Company December 1, 1977. Available in NRC PDR for inspection and copying for a fee.

30. NRC Commission Staff Paper, "Assessments of Relative Differences in Class 9 Accident Risks in Evaluations of Alternatives to Sites with High Population Densities" SECY-78-137, March 7, 1978. Available in NRC PDR for inspection and copying for a fee.

31. ALAB-489, "Decision by the Atomic Safety and Licensing Appeal Board In the Matter of Offshore Power Systems (Floating Nuclear Power Plants)", Docket No. STN 50-437, August 21, 1978. Available in NRC PDR for inspection and copying for a fee.

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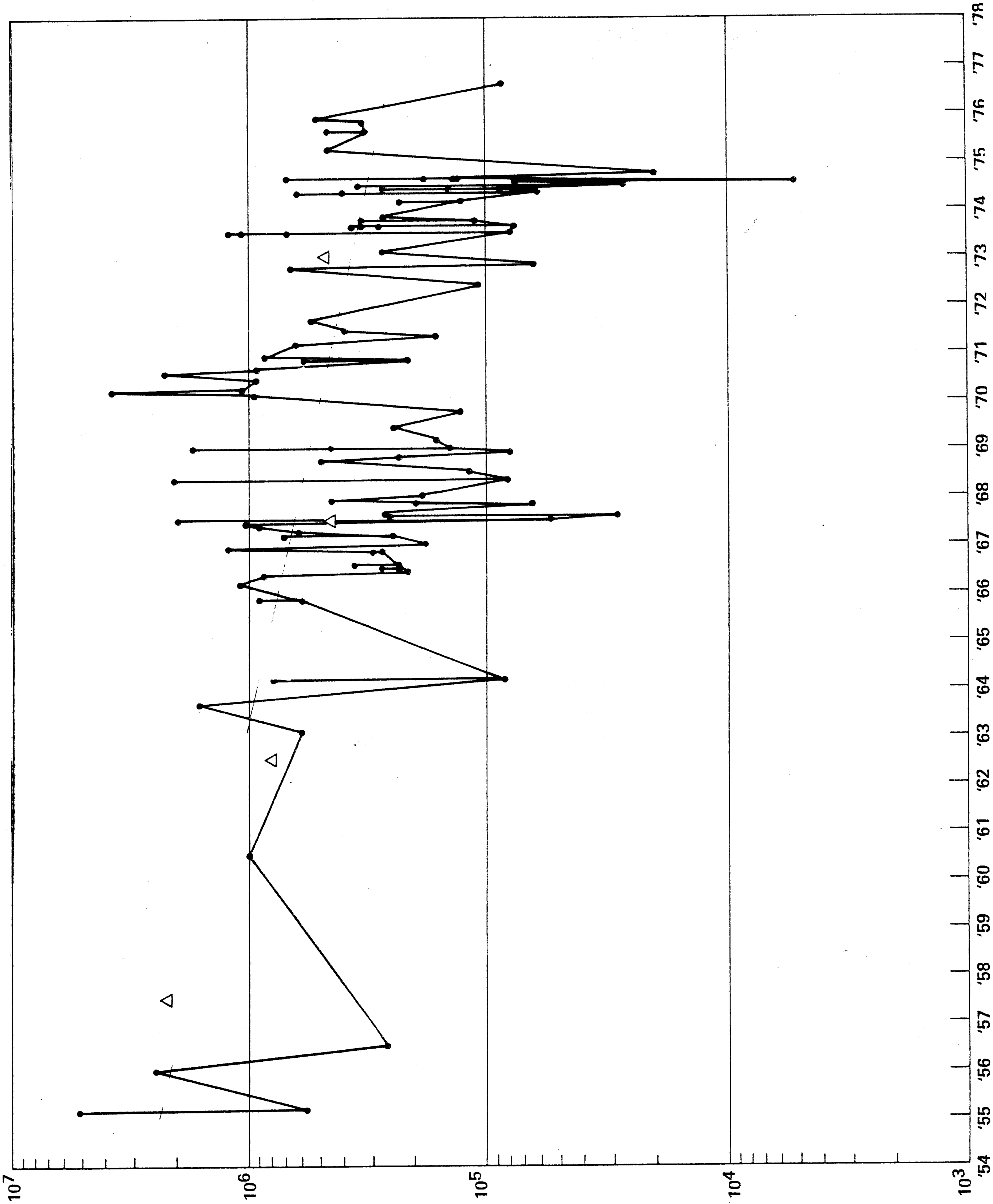
TABLE I

Population (1000's) At Selected Sites

	State	Applied	MWt	0-5 mi	0-10 mi	0-20 mi	0-30 mi	0-40 mi	0-50 mi	0-10 mi Worst Sector
Metropolitan Sites										
Bolsa Island	Ca	1965	3000	210	1000	3000	6000	7900	8900	140
Burlington	N.J.	1966	3100	190	660	3300	4700	5700	7800	120
Edgar	Mass.	1964	2000	200	950	2600	3300	4700	5600	310
Newbold Is.	N.J.	1969	3440	100	490	1500	4200	6200	8400	120
New Rochelle	N.Y.	1963	2030	470	2800	10,000	14,000	16,000	17,000	380
Ravenswood	N.Y.	1962	2030	280	7100	12,000	15,000	16,000	17,000	970
500 People/Sq. mi	-	-	-	39	160	630	1400	-	-	-
"Densely Populated Sites"										
Bailly	Ind.	1970	1931	20	92	610	2300	5100	6800	30
Conn. Yankee	Conn.	1963	1825	12	160	900	1600	2700	3200	29
Fermi*	Mich.	1955	200	10	70	420	2400	4400	5200	22
Indian Pt.*	N.Y.	1955	615	64	210	920	4300	11,000	16,000	32
Limerick	Penn.	1970	3293	62	150	780	3700	5700	6600	26
Malibu	Ca.	1962	1473	3.5	25	100	4000	6300	7800	7
Midland	Mich.	1969	2452	41	62	340	470	580	1000	12
Millstone	Conn.	1965	2011	46	110	270	430	1100	2500	35
Perryman	Md.	1973	3500	15	87	530	1800	2400	3600	15
Rome Pt.	R.I.	1971	2700	38	140	710	1300	1800	2500	31
Shippingport*	Penn.	1953	505	17	140	470	1700	2900	3600	31
Shoreham	N.Y.	1968	2436	11	45	360	1700	2800	5100	16
Verplanck	N.Y.	1969	3440	64	210	920	4300	11,000	16,000	32
Zion	Ill.	1967	3000	42	210	530	1300	4000	7000	74

*Additional, large LWR's later constructed at same site



POPULATION WITHIN A 30 MILE RADIUS OF THE PLANT SITE

FIGURE 1

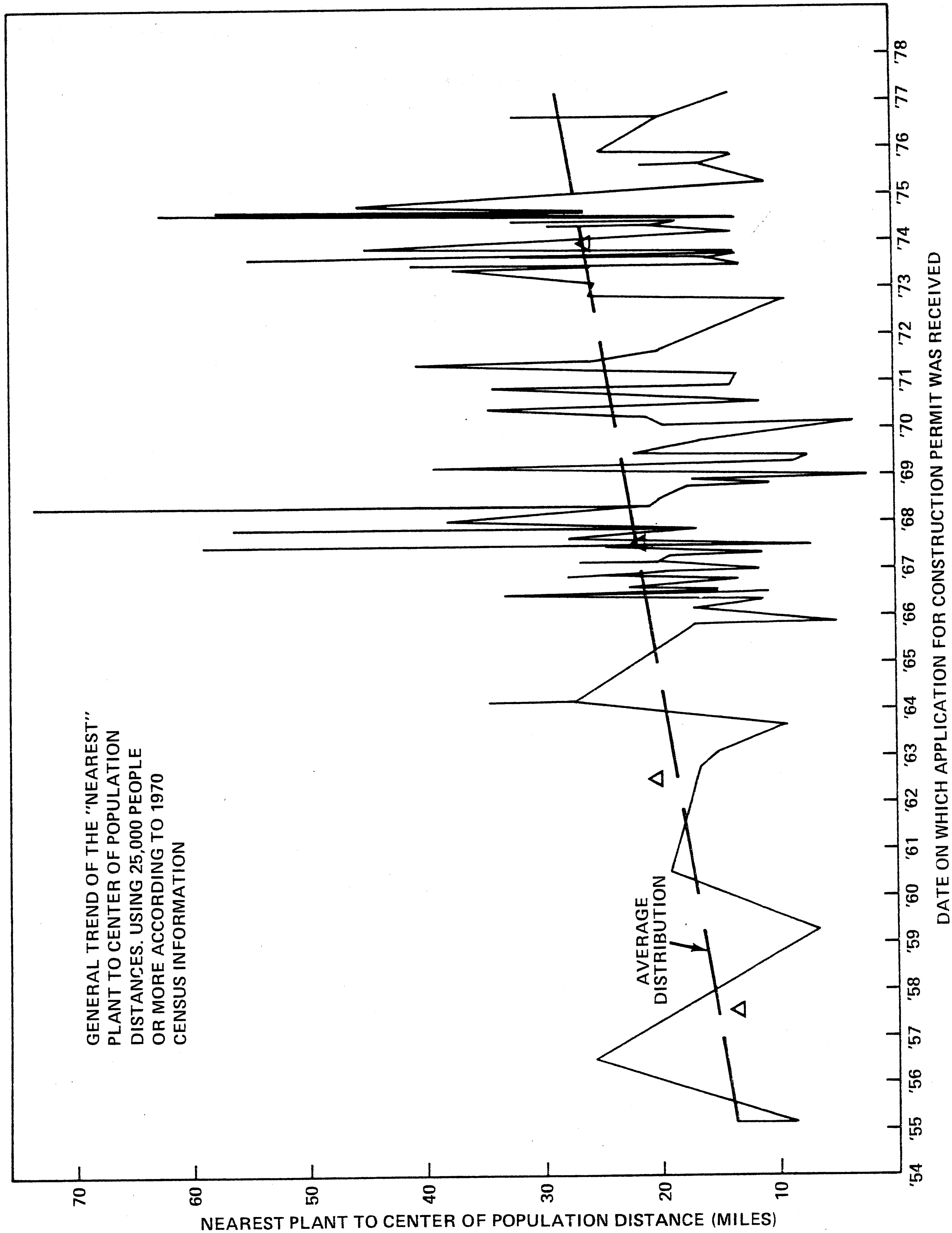

GENERAL TREND OF THE "NEAREST" PLANT TO CENTER OF POPULATION DISTANCES. USING 25,000 PEOPLE OR MORE ACCORDING TO 1970 CENSUS INFORMATION
AVERAGE DISTRIBUTION
DATE ON WHICH APPLICATION FOR CONSTRUCTION PERMIT WAS RECEIVED
'54 '55 '56 '57 '58 '59 '60 '61 '62 '63 '64 '65 '66 '67 '68 '69 '70 '71 '72 '73 '74 '75 '76 '77 '78
NEAREST PLANT TO CENTER OF POPULATION DISTANCE (MILES)
10 20 30 40 50 60 70

FIGURE 2

APPENDIX A

1. Letter, W. F. Libby, Acting Chairman, U. S. Atomic Energy Commission to Honorable Bourke B. Hickenlooper, Joint Committee on Atomic Energy, Congress of the United States, March 10, 1956.

2. Letter, Bourke B. Hickenlooper to Dr. Roger McCullough, Chairman, Advisory Committee on Reactor Safeguards, February 15, 1956.

UNITED STATES
ATOMIC ENERGY COMMISSION
WASHINGTON, D. C.

March 14, 1956

Dear Senator Hickenlooper:

In your letter of February 15, 1956, to the Commission's Advisory Committee on Reactor Safeguards, you asked for categoric, concise answers to three questions dealing solely with the relationship between reactor isolation and possible hazards to the public.

Regardless of location or isolation, there is no such thing as an absolutely safe nuclear reactor -- just as there is no such thing as an absolutely safe chemical plant or oil refinery. There is always present, regardless of the remoteness of its probability, a finite possibility of the occurrence of an event, or series of events, the result of which is the release of unsafe quantities of radioactive material to the surrounding area. Should such a release occur, the number of persons receiving excessive radioactive exposure would, of course, be directly related to the density and distribution of population in the area surrounding the reactor.

It follows that the answer to each of the three questions you raise is "yes". Thus, there is a remote possibility of danger to citizens in the vicinity of the Shippingport reactor or any other sizeable reactor, and, it is, therefore, more desirable from the standpoint of safety alone to locate reactors in areas of low, rather than normal, population density.

Such answers, standing by themselves can, however, be misleading and could result in misunderstanding and misconception. For this reason, I should like to expand my answers to include a discussion of some of the more important factors which we must consider in determining the location of any given reactor.

As previously stated, if considerations were given to safety factors alone, atomic reactors should be located in areas of lowest possible population density. However, the growth and development of an atomic energy industry cannot proceed under conditions of isolation which are significantly different from those which have been found to be applicable to most other industries.

While it is true that the potential danger to the public from a nuclear accident is only that of the release of radioactive materials and not that of an atomic explosion, still the maximum conceivable damage which can be caused by such an accident is far greater than that which can result from normal industrial accidents. Therefore, it is incumbent upon

the new industry and the Government to make every effort to recognize every possible event or series of events which could result in the release of unsafe amounts of radioactive material to the surroundings and to take all steps necessary to reduce to a reasonable minimum the probability that such events will occur in a manner causing serious overexposure to the public.

The licensing provisions of the Atomic Energy Act of 1954 have made it possible for the Commission to establish a regulatory program designed to assure that these objectives will be achieved. Under our regulations no license will be issued for the operation of any reactor, regardless of size or intended use, until the scientists and engineers who conceived and designed the reactor have made a complete evaluation of all potential hazards of their particular reactor, and of the adequacy of the steps they have taken in design and operating procedures to minimize the probability of occurrence of an accident which would result in the release of unsafe quantities of radioactive materials to the surroundings. This evaluation, which is reported in a detailed "Hazard Summary Report" to the Commission, is used by the technical experts on the Commission's staff working in close collaboration with the experts of the Commission's Advisory Committee on Reactor Safeguards to determine whether or not the operation of the reactor can be carried out in a manner that gives reasonable assurance that the health and safety of the public will not be endangered.

The financial incentive of the owners of the reactor to take all steps necessary to protect their investment, as well as to decrease their potential public liability, and the legal and moral responsibilities of the Commission to protect the public from overexposure to radioactivity, are resulting in a system which is characterized by an attitude of caution and thoroughness of evaluation unique in industrial history. Every phase of the reactor design and operating procedure is reviewed separately and as a part of the whole. The inherent nuclear, chemical, metallurgical, physical and mechanical characteristics of the fuel, moderator, coolant, neutron absorbers and structural materials are carefully considered in connection with the electrical, mechanical, chemical, physical, metallurgical and nuclear characteristics of the control and safety systems, the heat removal systems, the pressure systems, and so on, to assure that the probability of an operating mishap has by adequate design and operating precautions been brought to an acceptably low level.

Not only must the evaluation show that the designers have taken all reasonable precautions to assure that the probability of a mishap is satisfactorily low, it must further show what steps have been taken to protect the public in the event the highly improbable incident did occur and unsafe quantities of radioactive materials were released from the reactor itself. It is in this evaluation of what is essentially a vital second line of defense for the public that the relationship of the characteristics of the location of the reactor to the ability of the building to contain radioactive materials which might be released becomes an important

factor. It is during this phase of the study that the hydrology, meteorology, geology and seismology of the area; the existing and potential population density and distribution; the type of existing and potential activity in the area (i.e., agricultural, commercial, industrial, residential, etc.); the use of the surface and surface waters for industrial or personal consumption; and other factors pertinent to the specific location, are considered in order to be sure what the degree of containment is adequate for the location chosen.

If, for example, it is possible to show that under the most adverse set of circumstances which might occur, the structure of the building containing the reactor would not be expected to allow the release of any significant amount of radioactive materials into the surrounding area, such factors as the proximity of the reactor to densely populated areas would be less important than otherwise. Likewise, if the distance from densely populated areas were so great that under the most adverse conditions it would be reasonable to expect that there would be little exposure of the public, the degree of containment would not be so important.

It is expected that power reactors, such as that new under construction at Shippingport, Pennsylvania, will rely more upon the philosophy of containment than isolation as a means of protecting the public against the consequences of an improbable accident, but in each case there will be a reasonable distance between the reactor and major centers of population.

In summary, then, our safety philosophy assumes that the potential danger from an operating atomic reactor is very great and that the ultimate safety of the public is dependent upon three factors:

1. Recognizing all possible accidents which could release unsafe amounts of radioactive materials;

2. Designing and operating the reactor in such a way that the probability of such accidents is reduced to an acceptable minimum;

3. By appropriate combination of containment and isolation, protecting the public from the consequences of such an accident, should it occur.

Sincerely yours,

/s/

W. F. Libby
Acting Chairman

Honorable Bourke B. Hickenlooper
Joint Committee on Atomic Energy
Congress of the United States

CONGRESS OF THE UNITED STATES
JOINT COMMITTEE ON ATOMIC ENERGY

February 15th, 1956

Advisory Committee on Reactor Safeguards
Atomic Energy Commission
Washington 25, D. C.

Attention: Dr. Roger McCullough, Chairman

Gentlemen:

As a member of the Joint Committee on Atomic Energy, also as a member of the Senate and as a citizen, I am, and have been, concerned about the question of safety of the public involved in the location and operation of atomic reactors. I would, therefore, like to ask the following questions, which to my knowledge have not been answered heretofore, and I shall appreciate categoric concise answers.

1. Will the operation of the reactor presently under construction at Shippingport, Pennsylvania, create any potential dangers or the possibility of danger to the citizens in that densely populated area? (This question includes not only the possibility of hazards under so-called normal operation, but hazards or injury which could come from human error in operating the reactor or from natural catastrophe, sabotage or enemy attack.)

2. I ask the same question about the operation of sizeable commercial type reactors so far as they might be located in any other area of average or concentrated density in the United States.

3. Is it and will it be, in the light of all present knowledge and that anticipated in the foreseeable future, more desirable, from the standpoint of safety to the public against actual or possible danger or injury, to locate such reactors in areas of practically no density of population, such as, for instance, the Arco area, rather than in areas of populations of normal to concentrated density?

Yours sincerely,

/s/
Bourke B. Hickenlooper

APPENDIX B

Letter, H. L. Price, Director of Regulation, U. S. Atomic Energy Commission to Mr. Arthur C. Perry, Assistant to Vice President, Office of the Vice President, April 24, 1963.

April 24, 1963

Mr. Arthur C. Perry
Assistant to the Vice President
Office of the Vice President
Washington 25, D. C.

Dear Mr. Perry:

This is in reply to your April 10, 1963 letter to the Atomic Energy Commission requesting information covering requirements or restrictions by the Commission as to selection of sites for atomic energy plants.

The criteria which guide the Commission in its evaluation of the suitability of proposed sites for licensed stationary power and testing reactors are contained in Part 100 of the Commission's Regulations. The criteria identify a number of factors considered by the Commission in evaluating reactor sites and the general criteria used as guides in approving or disapproving proposed sites.

The factors identified in Part 100 include the characteristics of reactor design and proposed operation (including power level, extent to which generally accepted engineering standards have been applied to the reactor design, extent to which the reactor incorporates unique factors having a significant bearing on the probability or consequences of an accidental release of material, safety features that are engineered into the facility, etc.), population density and use characteristics of the site, physical characteristics of the site and, where unfavorable physical characteristics of the site exist, the extent to which the design of the facility includes adequate compensating engineered safeguards.

As an aid in evaluating a proposed site, Part 100 required an applicant to assume a fission product release from the core of his proposed nuclear power plant, the expected demonstrable leak rate from the containment and the meteorological conditions pertinent to the proposed site. On the basis of these assumptions, the applicant is then expected to calculate an "exclusion area," a "low population zone" and a "population center distance."

The terms "exclusion area", "low population zone" and "population center distance" are defined in Part 100. The "exclusion area" calculated by the applicant should be of such size that an individual located at any point on its boundaries for two hours following the postulated fission product release would not receive radiation exposure to the whole body excess of 25 rem, or a radiation dose to the thyroid from iodine exposure in excess of 300 rem. The "low population zone" so calculated should be such that

an individual who is exposed to the radioactive cloud resulting from the postulated release of fission products and who is located on its outer boundary would not receive radiation exposure to the whole body in excess of 25 rem or to the thyroid in excess of 300 rem from iodine exposure.

The "population center distance" should be at least 1 1/3 times the distance from the reactor to the outer boundary of the low population zone. The criteria in Part 100 point out that where very large cities are involved, a greater distance (than 1 1/3 times the distance from the reactor to the outer boundary of the low population zone) may be necessary because of total integrated population dose considerations.

As an aid to license applicants in deriving the exclusion area, low population zone and population center distance, the Commission has published in TID-14844 (March 23, 1962) a procedural method and a sample calculation for a hypothetical reactor. This sample calculation may be used as a beginning point for evaluation of a proposed site. The distance can be adjusted either upward or downward depending upon the physical characteristics of the proposed site and the characteristics of the proposed reactor, such as the leak rate of the containment and the engineered safeguards which are provided.

For example, in TID-14844 a containment leak rate of 1/10th of 1% per day was assumed. When a facility is proposed with special containment features and a different leak rate, these differences have to be evaluated. In recent years improvements have been developed in containment design, and as time goes on the results of research and development work may lead to further improvements in engineered safety features, which may also have a bearing on site acceptability.

From the foregoing summary, it is apparent that the suitability of a site for any particular reactor cannot be determined from the guides in Part 100 simply by calculations or by any rule of the thumb. Rather, application of the criteria depend very substantially upon detailed analysis and evaluation of specific characteristics of the particular reactor involved and its engineered safeguards and the site proposed for the plant. That the criteria in Part 100 are general guides, and not readily calculable requirements, is emphasized in the preamble as well as the text of Part 100. As stated in the preamble, "These guides and the technical information document are intended to reflect past practice and current policy of the Commission of keeping stationary power and test reactors away from densely populated centers. It should be equally understood, however, that applicants are free and indeed encouraged to demonstrate to the Commission the applicability and significance of considerations other than those set forth in the guides."

I am enclosing, for your information, a copy of the reactor site criteria guides (Part 100 of the Commission's Regulations) and a copy of TID-14844, "Calculation of Distance Factors for Power and Test Reactor Sites," which are the bases for the above remarks.

Sincerely yours,

/s/
H. L. Price
Director of Regulation

Enclosures:
1. Part 100
2. TID-14844

APPENDIX C

Testimony of Commissioner James T. Ramey before the Joint Committee on Atomic Energy, June 22, 1965 (appears on pp. 34-39 of Hearings Before the Subcommittee on Legislation of the Joint Committee on Atomic Energy, Congress of the United States, Eighty-Ninth Congress, First Session on Proposed Extension of AEC Indemnity Legislation, June 22, 23 and 24, 1965).

AEC SITE CRITERIA AND SAFETY ACTIVITIES

Mr. Ramey. This is on our site criteria and our activities relating to safety.

In April of 1962 the AEC issued Reactor Site Criteria (10 CFR 100) to guide evaluation of proposed sites for stationary power reactors, primarily of the pressurized and boiling water types. These guides were developed in consultation with the AEC statutory Advisory Committee on Reactor Safeguards and the nuclear power industry. One of the objectives of these guides was to familiarize industry, State and local officials and the general public with the factors considered by AEC in evaluating proposed reactor sites.

In acknowledging the continued need for competent technical judgment by both the applicants and the AEC in implementation, flexibility was deliberately written into the guides. The Commission endeavored to set forth the criteria in such a way that they could be administered in an evolutionary manner. In so doing, it was recognized that insufficient experience had been accumulated to permit the writing of detailed standards for either the design or the siting of reactors.

The basic principle underlying the reactor safety program is recognition of the necessity for effective engineered safeguards in the construction and operation of reactors both to prevent major accidents and to control their consequences in the unlikely event they should occur. Under the site criteria (see p. 36 for digest of site criteria), provision is made to balance such engineered safeguards in relation to the distance between reactor and population centers. The application of this concept has had the effect of continuing the AEC practice of keeping central station power and test reactors a reasonable distance from densely populated centers.

The safety record achieved by the nuclear power industry has been outstanding. In no instance has a reactor accident in the operation of a central station electrical generating reactor plant caused any radiation damage to the public or its environment, or to the plant workers. These operations in the United States have involved the production of over 14 billion kilowatt hours of electrical energy.

This exemplary safety record is the result of the general recognition by the Commission and the industry of the problems of potential accidents; and the application of sound engineering principles in the design and the construction of reactor systems and appurtenances. The Commission's research, development and test program have materially assisted designers in specifying proper system requirements and safety evaluators in assessing

the safety of specific system designs. One part of the Commission's research and development program identified as nuclear safety is budgeted at about $24 million in fiscal year 1966 (see p. 37 for a summary of this nuclear safety program).

The participation of industry has been most encouraging and many recent and improved safety systems have been developed through their efforts; more definitive and uniform criteria for the construction and operation of power reactors have evolved. Efforts along these lines are continuing and are recognized as vital to the healthy growth of the industry. Consequently, it has been possible in recent years to accept certain engineering safeguards as a partial substitute for the amount of geographic isolation formerly required.

The rapid expansion and development of the nuclear power industry involving different reactor types and increased reactor size for broader applications (for example, desalting), and the incentives to locate in closer proximity to metropolitan load centers, have focused attention on the continuing need for careful attention to all matters which potentially could affect the health and safety of the public. Consequently, further important advances in reactor plant design, in the capability of safety systems and engineered safeguards, in adapting critical components and systems to accommodate their inspection and testability, and in practical demonstration of dependability of performance of such critical systems, must evolve to keep pace with the development of the nuclear power industry.

In recognition of these increasing needs, the Commission has decided to augment efforts and redirect emphasis to define and develop the improvements in reactor plant design and capability of critical system and engineered safeguards. This effort will be carried on in cooperation with industry and in conjunction with the Commission's safety research and development programs in order to obtain the accumulation of meaningful experience with respect to capability and reliability of important safety systems. In the course of this undertaking, new and improved methods must be developed for design, construction, and operation of central station reactors from the standpoint of safety, including means of testing and inspecting the safety aspects of important systems. Additional efforts also will be undertaken, in cooperation with appropriate groups, in the development of standards and codes for the design and construction of reactors and their principal components.

This research and development work, together with increased emphasis on the development of more specific reactor standards will be necessary as reactors increase in size and are built closer to metropolitan load centers.

As the augmented reactors safety program progresses, the Commission will continue to consider applications for reactor construction permits and operating licenses on a case-by-case basis. As new data and improved safety devices are developed, they will be taken into account in the regulatory process. In recognition of this evolutionary development, the AEC has encouraged applicants and industrial organizations to come in and obtain informal review of their siting problems and reactor plant and component design. In this manner, maximum advantage can be taken of the current knowledge and proposed plans as these may affect the health and safety of the public and the growth of the nuclear power industry.

Chairman Holifield. Would you like to have the attachments to your statement introduced at this point in the record?

Mr. Ramey. Yes, sir. We would also appreciate if you would incorporate in the record our background statement on reactor licensing procedures and reactor safety. (See app. 3, p. 239.)

Chairman Holifield. Without objection, those items will be received for the record.

(The statements referred to follow:)

[Attachment No. 1]

DIGEST OF SITE CRITERIA

The Atomic Energy Commission published "Reactor Site Criteria" Part 100, title 10, Code of Federal Regulations, as an effective regulation on May 12, 1962.[1] The fundamental purpose of Part 100 is to provide guides for the evaluation of the suitability of proposed sites for stationary power and testing reactors. The regulation specifically recognizes that insufficient experience has been accumulated to permit the writing of detailed standards and emphasizes that Part 100 is intended as an interim guide to identify a number of factors considered by the Commission in evaluating reactor sites.

The particular factors considered in determining the acceptability of a site are the characteristics of reactor design, including power level, safety features and similar design considerations, population density and use characteristics of the similar design considerations, population density and use characteristics of the environs, physical characteristics of the site, and the engineered safeguards designed to minimize the consequences of any accident.

The point of departure for the evaluation of site suitability and plant design is the concept of the "maximum credible accident." This represents the upper limit of practical hazard to the public which can be expected from the proposed facility.

[1] 27 F.R. 3509.

The guides make explicit and define the concepts of population zones around a reactor which had been observed in practice all along by the Commission; the exclusion zone, where people, if any, are highly mobile and under the direction of the reactor operator in emergencies; the next succeeding low population zone, where evasive or protective measures for people could be taken in case of dangerous releases from the plant; and the city distance, where people are not very mobile, but the distance is sufficient to prevent the worst aspects of danger should a serious accident occur.

The guides provide numerical values for potential radiation exposure doses that might occur to offsite personnel in case of a maximum credible accident for the reactor in question, to be used as measuring indexes for evaluating the acceptability of the reactor in the site proposed.

The guides identify problems of meteorology, hydrology, and seismology which must be considered in evaluating the suitability of a site.

Finally, the principle is articulated that "where unfavorable physical characteristics of the site exist, the proposed site may nevertheless be found to be acceptable if the design of the facility includes appropriate and adequate compensating engineering safeguards." This has been interpreted to mean that where appropriate and adequate compensating safeguards are provided, there may be some reduction in the isolation distance of the reactor which otherwise would be required.

[Attachment No. 2]

SUMMARY OF NUCLEAR SAFETY PROGRAM

In augmentation of selected results from individual reactor projects and technical programs, the nuclear safety research, development, and test program coordinates the technology, focuses effort, and provides data and information required for the location, design, construction, and operation of safe reactors and the application of reliable engineered safeguards for effective accident prevention and control.

The primary objective of the nuclear safety program is to provide sound technical bases for designing safe reactors and preventing accidents by obtaining quantitative data from a coordinated sequence of laboratory studies and experiments and engineering scale tests, and through improved analytical techniques and processes. Concomitantly, the program's objective is also to provide the required technical bases for evaluating the safety of proposed reactor designs and installations.

The nuclear safety program includes the following:

1. Nuclear safety research and development, which involve both fundamental and applied research in nuclear reactor safety, including studies in reactor kinetics, fuel meltdown, phenomena and fuel-coolant interactions (chemical reactions), reactor containment, and other engineered safeguards, including those related to first reactor safety studies.

2. Effluent control research and development, which is directed toward the development of more effective means of managing radioactive wastes resulting from nuclear reactor operations, and toward determining and controlling the behavior of these residual radioactive effluents in the environment.

3. Engineering field tests which extend laboratory scale test results on both aerospace and terrestrial nuclear systems into full engineering scale field test results.

4. Reactor safety analysis and evaluation, which conduct safety analysis studies that supplement other program activities, and provide assistance in planning and directing the overall nuclear safety program.

The kinetics program is characterized by the SPERT reactors which involve study of all phases of abnormal reactor behavior including nuclear excursions beyond the threshold of damage.

Reactor containment studies include large-scale experiments of energy releases, the efficiency of engineered safeguards, fission product release and control, and pipe rupture.

Work carried out under effluent control research and development includes environmental studies associated with the safe disposal of radioactive effluents into the environment including gaseous activity, low, intermediate, and high activity waste disposal, the development of waste treatment processes, and the development of countermeasures for trapping fission products resulting from a reactor accident.

The engineering test program is characterized by the LOFT program which involves the test and control of a full-scale loss of coolant accident for a 50-megawatt (thermal) pressurized water reactor. In many respects, this program is the synthesis of and focus for other parts of the safety program. The aerospace safety program is also conducted under this activity.

The nuclear safety analysis and evaluation effort involves the coordination of safety related work outside of the base safety programs, pressure vessel research, safety analysis of reactors, surveys of reactor operating experience and adequacy of engineered safeguards, probabilistic studies of reactor accident occurrence, and nuclear safety data dissemination.

Currently, an important part of the analysis and evaluation work is the initiation of development of more uniform and better engineering codes, material and component specifications, and quality control and inspection practices. It is intended that ultimately there will be a comprehensive set of codes or specifications for all components of reactor systems that, if properly implemented and followed through, will maximize the safety of reactors at any location, both in terms of protecting the public and maintaining the integrity of the operating plant.

APPENDIX D

Letter, Glenn T. Seaborg, Chairman, U. S. Atomic Energy Commission, to Honorable Richard J. Hughes, Governor of New Jersey, October 24, 1967.

October 24, 1967

Honorable Richard J. Hughes
Governor of New Jersey
Trenton, New Jersey 08625

Dear Governor Hughes:

Thank you for your letter of September 11, 1967, regarding the Public Service Electric and Gas Company's application to the Atomic Energy Commission for a Construction Permit for their proposed Burlington Nuclear Generating Station Unit No. 1.

Since my previous letter to you of July 18, 1967, regarding the status of this application, the Advisory Committee on Reactor Safeguards has held a subcommittee meeting together with a site visit on August 9. This meeting was attended by AEC regulatory staff members and by Public Service Company representatives. The full Advisory Committee meeting with the AEC staff and the company was held on August 11, as was scheduled. After these discussions concerning site suitability, representatives of the Public Service Company informed us of their intention to locate this plant on an alternate site.

I appreciate your comments regarding some of the current problems of reactor siting. The nuclear industry is developing reactor designs of higher and higher power levels and with longer and longer fuel cycles in response to the growing power needs of the United States. Concurrent with this development, there is an increasingly strong economic incentive to locate new large central station power units in our near metropolitan areas or load centers. The combination of these factors creates siting problems which involve complex considerations of both policy and technology.

The objective of the Atomic Energy Commission is to encourage the growth of the nuclear power industry and the more effective utilization of this national energy resource, while at the same time insuring that reactors are designed, built, and operated in a manner which will safeguard the health and safety of the general public. Historically, reactors of novel design or of substantially increased power levels have been located at some distance from metropolitan centers, and generally the position of the Commission has been that experience in the design, construction, and operation of a particular type of reactor is required before it will approve siting of that type in a densely populated area. While the Commission believes that plants currently being licensed are safe, we consider it prudent to follow a conservative approach to the siting of large nuclear power plants.

The continuing research and development programs carried out by the Atomic Energy Commission and by private industry, advances in the technology of nuclear power plants, developments in the design of engineered safety features, and a growing body of operational experience are all resulting in ever-increasing assurance of the safety of these plants.

Sincerely,

Chairman

APPENDIX E

Letter, L. Manning Muntzing, Director of Regulation, U. S. Atomic Energy Commission to Mr. Robert L. Smith, President, Public Service and Gas of New Jersey, October 5, 1973.

October 5, 1973

Mr. Robert L. Smith
President
Public Service Electric and Gas of New Jersey
80 Park Place
Newark, New Jersey 07101

Dear Mr. Smith:

The Regulatory staff is now in the process of completing a Final Environmental Statement for the Newbold Island Nuclear Power plants.

An important requirement in the preparation of an environmental impact statement for a nuclear power plant is, of course, a consideration of alternative sites. On the basis of balancing all the various factors which must be considered at this location, including, particularly, population distribution, the staff concludes that the alternative location of these facilities at Artificial Island, adjacent to Salem Units 1 and 2, which are presently under construction, is a more desirable alternative from an environmental standpoint. This conclusion will be incorporated in the Final Environmental Statement of the Newbold Island nuclear power plants.

The principal factor leading to this conclusion is the fact that the population density at the Newbold site is significantly larger than at the Salem location. For instance, our projections for 1980 show that within five miles distance, the Salem location will have a population of about 4,700 persons, and the Newbold Island site will have approximately 125,000 persons. Within a 30-mile radius in 1980, Salem will have about 1,000,000 persons whereas Newbold Island will have over 4,300,000.

We are informing you of this conclusion prior to the issuance of a Final Environmental Statement so that if you should decide to accept the staff's position, an amendment to this application to change the plant location can be prepared as soon as possible. In the event you should decide to amend the application to use the Salem site, the staff would be prepared to be ready for a hearing within four months after receiving the amendment. This is possible because of the Final Environmental Statement issued for Salem 1 and 2 on April 4, 1973, as well as the fact that the Newbold plant has been subjected to a safety review. A change in the design of the Newbold plant, however, would require additional time for our review. If you elect to continue to pursue the Newbold location, please let us know

promptly so that we can then complete the Final Environmental Statement and proceed to a hearing on it.

Very truly yours,

/s/
L. Manning Muntzing
Director of Regulation