EARLY SITE PERMIT SELECTION COMMITTEE NOTEBOOK

SECTION 1

EXECUTIVE SUMMARY
ESP Site Selection
December 6, 2001

Background

Entergy Nuclear Site Selection Committee has evaluated Entergy Nuclear existing nuclear sites for consideration to prepare an Early Site Permit (ESP), under 10CRF52 Nuclear Regulatory Commission (NRC) regulations, to improve and streamline the future option of constructing a nuclear power plant, using a standardized certified design. With an ESP in hand and a Certified Design, the challenges and risk to commercialization and capital of a nuclear project are greatly reduced. The first step in the ESP process is to select a site (or sites) for which an ESP will be prepared.

The ESP Site Selection Committee was tasked to identify, from the fleet of seven existing plant locations, sites at which an ESP would provide:

- A site or sites that will be suitable for developing future nuclear power plants, taking into account engineering and environmental factors, within the new regulatory framework.
- optimum learning and experience from the ESP application development and review processes,
- options for and flexibility in capitalizing on future electric market trends,
- favorable public acceptance for a new nuclear power plant

  NOTE: Current NRC regulations are based on Light Water Reactors consequently some sites might appear to be less suitable than others using current requirements. However if prevailing market indications shows a demand, then these sites should be revisited when regulations change to accommodate advanced Gas Reactors or Generation IV plants.

The Early Site Permit is good for 10 to 20 years and may be renewed for an additional 10 to 20 years. The ESP process is a long-range planning tool with applicability well beyond the near term market view available with any significant accuracy. (Current estimates are 2010 is the earliest a new certified nuclear unit could be commercial) Processes, criteria, and decisions were framed by the objective of optimizing the value of an ESP in the near term, as distinct from those factors that would be applied to immediate-term construction of a nuclear power plant. In other words, the final selection was not dominated by current or near term market views but rather was driven by the overall technical acceptability of the site to receive an ESP.

Process Summary

The Region of Interest (ROI) selected for examining potential sites is the existing Entergy fleet of seven existing sites. Justification for this ROI is based on the multiple advantages enjoyed by existing sites in both technical and public acceptance aspects of the licensing process (Sections 2 and 3). Since new units could be developed at any of the seven sites, the diversity of sites available, combined with advantages of existing sites, clearly justify limiting the ROI to Entergy's existing nuclear units. Restricting the ROI to the existing seven sites also had the affect of lessening the importance of the power marketing factor. This is due to the fact that selection of one's ROI is generally a market driven decision first followed by the final selection being technical and public acceptance driven.

Initial Screening (Seven sites to four) – Sections 2 and 3

The decision process for analyzing the potential sites was derived from *Siting Guide: Site Selection and Evaluation Criteria for an Early Site Permit Application* (Reference 1). First, the seven sites were screened, using the existing site criteria listed in Section 4.2 of Reference 1 (plus a public relations criterion), to identify four candidate sites (two in the south and two in the northeast). Processes for and results of this initial screening are reported in Sections 2 and 3.

All existing nuclear sites were initially assumed to be viable for new nuclear plant addition. When analyzed against exclusionary and avoidance criteria of the new regulations one plant was eliminated (Indian Point) and one challenged (Pilgrim) on population density and project population growth. Population density around Indian Point exceeds 500 persons per square mile. Current NRC guidance indicates that the population density for sites being proposed for nuclear power plants should not exceed this figure, especially if other alternatives exist. For this reason, Indian Point was excluded from further consideration, and ratings for the other criteria were not developed for this site. However, it should be noted that future technical developments in reactor design (e.g., modular gas cooled reactors) could provide a basis for relaxing current regulatory restrictions on population; such developments could provide additional opportunities for serving markets from the Indian Point site.

Waterford and ANO were each challenged by various avoidance criteria (i.e. wetlands, threats from industrial and other plants, thermal discharge limits, etc.) or transmission and market constraints. Both of these sites are viable for new nuclear plants, but were analyzed as less suitable than other southern sites.

Of the southern sites, Grand Gulf was rated higher than the other three candidates when considering all criteria. Of the remaining three southern sites, River Bend is ranked higher than the other two candidates (Arkansas Nuclear One and Waterford 3) for all but one of the criteria. Thus, Grand Gulf and River Bend were selected as the two sites in the south, with Grand Gulf ranking slightly higher. Grand Gulf was rated higher than River Bend from EWO's market intelligence because of its ability to feed external customers in the TVA and Southern Regions along with its ability, as with River Bend, to feed load centers in the New Orleans area. Potential changes in Clean Air regulations (especially CO_2) and the extensive use of coal in these regions give a nod to possible future nuclear capacity at Grand Gulf.

Criterion rankings for the remaining northern sites varied significantly by criterion with Fitzpatrick rated better (more than two points higher) than Pilgrim for Demographic Changes and Water Availability. Pilgrim was rated similarly better in Transmission Access and significantly better for Power Pricing. Selection of one of these sites over the other required development of net ratings using weighting factors, as described in Sections 2 and 3. Based on these results, Fitzpatrick was identified as the preferred site for preparation of an ESP in the northeast.

Detailed Screening (Four sites to two) – Section 4

The four candidates were characterized in accordance with criteria set forth in *Entergy Nuclear Site Selection Criteria Guidelines for an Early Site Permit* (Reference 2). Detailed analysis of each site with respect to each of the criteria was conducted using existing site data (e.g., ERs, SARs) and publicly available data. Results of these analyses were compiled in a draft report that included initial site ratings for each criterion; these ratings were reviewed and revised, as appropriate, at a meeting of the Committee on December 5, 2001. Weighting factors that reflect the relative importance of each criterion in site selection were developed via the same process as described for the initial screening in Sections 2 and 3.

The technical basis for ratings developed in individual criteria as applied to each site are provided in Section 4. Criterion ratings, weighting factors, and overall suitability scores for each of the four sites are summarized in attached Table Composite Suitability Section 4 Score.

Based on this analysis, all of the four sites were determined to be suitable for an ESP. Based on the composite suitability ratings (including both cost and environmental factors), Grand Gulf ranks highest, closely followed by Fitzpatrick. River Bend ranks next, with slightly lower overall scores, and Pilgrim ranks lowest. Based on these rankings, and on the judgement that Grand Gulf and Fitzpatrick sites satisfy the objectives of Entergy's ESP program (see Background above), these two sites were selected by the Committee as the top priorities for ESP development.

It should be noted that population data for Pilgrim indicates that there may be population densities around the site that exceed the NRC guideline of 500 persons/square mile within 20 miles of the plant. Although this factor may rule Pilgrim out of consideration based on current LWR regulatory requirements, future technical developments in reactor design (e.g., modular gas cooled reactors) could provide a basis for relaxing current regulatory restrictions on population; such developments could provide additional opportunities for serving markets from the Pilgrim site.

Based on the analysis described above and detailed in Sections 2, 3 and 4 (attached), the Committee makes the following recommendations.

1. Grand Gulf Nuclear Station is the first-priority site for development of an ESP. It enjoys excellent local public acceptance, has transmission access to potential markets to the east of the plant (Southern Company and TVA service territories), and was found to be the highest-ranking site in both rounds of the engineering and environmental suitability analysis.

2. The James A. Fitzpatrick plant is the next priority site for ESP development. JAF has good local public acceptance and also ranked near the top in the detailed engineering and environmental suitability analysis. Current transmission constraints between JAF and New York City restrain the ability to serve this load center at this time; however, an ESP at JAF will provide the platform for serving that load at such future time that these constraints are rectified.

These recommendations, which identify one site each in the southern and northern components of the Entergy fleet, would provide opportunities for gaining ESP experience in a diversity of regulatory and public acceptance environments, as well as variety of site-specific technical issues. ESPs at these sites would also position Entergy to capitalize on two separate power markets, as future developments reveal the optimum locations for a merchant nuclear power plant.

References

1. *Siting Guide: Site Selection and Evaluation Criteria for an Early Site Permit Application*, Final Report, Electric Power Research Institute, August 2001.

2. *Entergy Nuclear Site Selection Criteria Guidelines for an Early Site Permit*, Entergy Nuclear, Inc., August 2001.

Table 2. Composite Suitability Ratings for Sections 2 and 3

		ANO		GGN		JAF		PNS		RBS		W3	
Site Evaluation Factor	Weighting Factor	Score	Weighted Score	Score	Weighted Score	Score	Weighted Score	Score	Weighted Score	Score	Weighted Score	Score	Weighted Score
Seismic Evaluation	7.2	4	28.8	5	36.0	4	28.8	3	21.6	5	36	3	21.6
Demographic Changes	6.1	5	30.5	5	30.5	5	30.5	3	18.3	5	30.5	4	24.4
Emergency Planning	5.6	5	28.0	5	28.0	5	28.0	5	28.0	5	28	5	28.0
Exclusion Area	6.1	4	24.4	5	30.5	4	24.4	3	18.3	5	30.5	4	24.4
Transmission Access	8.2	2	16.4	5	41.0	3	24.6	5	41.0	3	24.6	3	24.6
Power Pricing	9.1	2	18.2	3	27.3	1	9.1	5	45.5	3	27.3	3	27.3
Water Availability	7.1	2	14.2	5	35.5	5	35.5	3	21.3	5	35.5	4	28.4
Permitting/Licensing Status	6.4	4	25.6	5	32.0	3	19.2	2	12.8	3	19.2	3	19.2
Plans for Existing Units	3.0	4	12.0	5	15.0	5	15.0	4	12.0	5	15	5	15.0
Spent Fuel Storage	2.6	5	13.0	5	13.0	5	13.0	4	10.4	5	13	5	13.0
Public Acceptance	6.6	5	33.0	5	33.0	3	19.8	2	13.2	5	33	4	26.4
Composite Rating			244.1		321.8		261.1		242.4		292.6		252.3

Table: Composite Suitability Section 4 Score

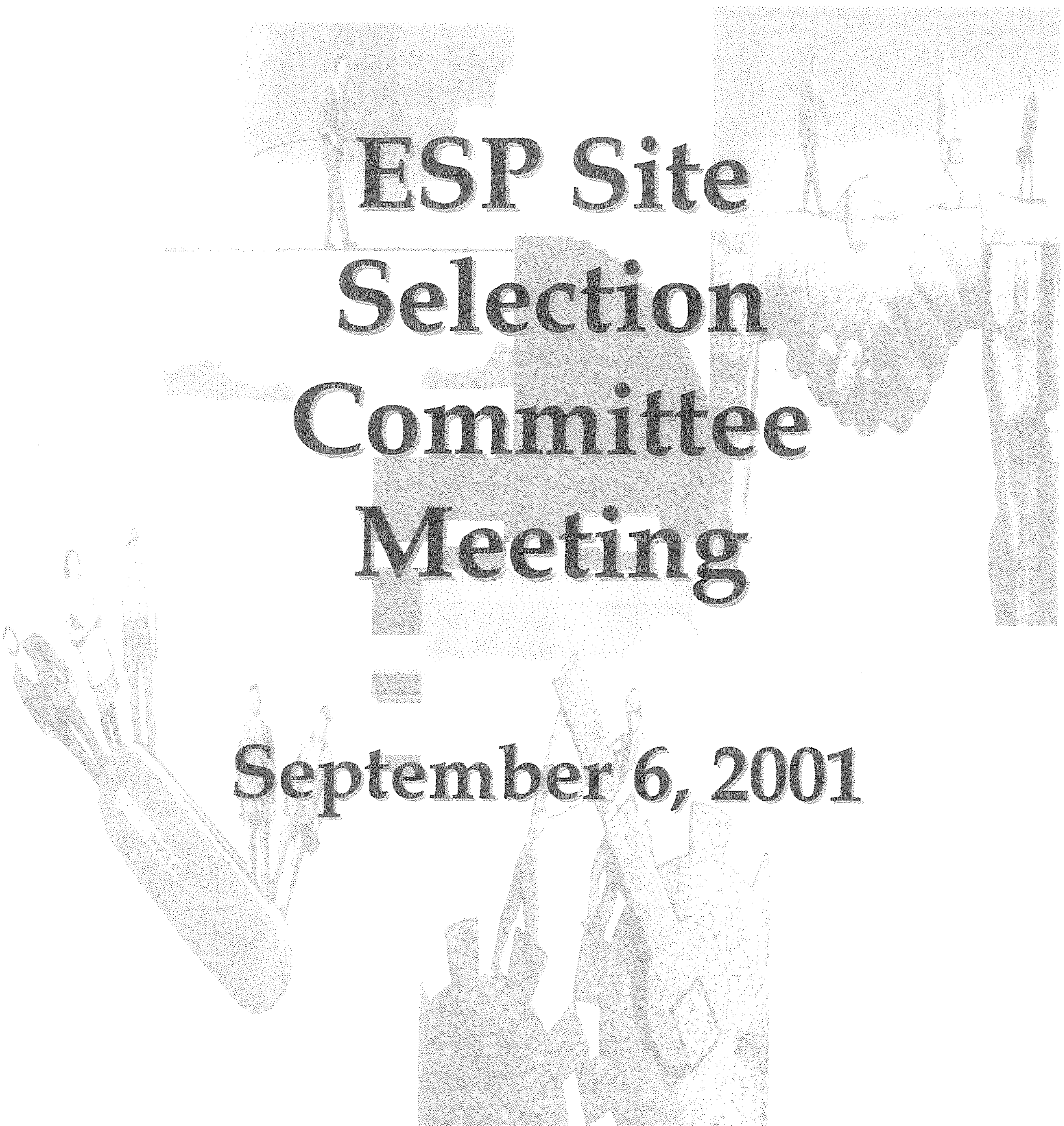
STEPS

	Criteria	Weight	GGN	GGN	JAF	JAF	PNS	PNS	RBS	RBS
A.1.1	Geology/Seismology (GEOL)	3.77	5	18.8	5	18.8	4	11.3	4	15.1
A.1.1.1	Vibratory Ground Motion	X								
A.1.1.2	Capable Fault	X								
A.1.1.3	Surface Faulting and Deformation	X								
A.1.1.4	Geologic Hazards	X								
A.1.1.5	Soil Stability	X								
A.1.2	Cooling System Requirements	3.27	4	13.1	5	16.3	5	16.3	4	13.1
A.1.2.1	Cooling Water Supply (HYDRO)	X								
A.1.2.2	Ambient Temperature Requirements (MET)	X								
A.1.3	Flooding (HYDRO)	2.40	3	7.2	5	12	5	9.6	4	7.2
A.1.4	Nearby Hazardous Land Uses (LU,SOCEC)	3.35	5	16.7	5	16.7	5	16.7	5	16.7
A.1.4.1	Existing Facilities	X								
A.1.4.2	Projected Facilities	X								
A.1.5	Extreme Weather Conditions (MET)	2.36	5	11.8	4	9.4	3	7.1	3	7.1
A.1.5.1	Winds	X								
A.1.5.2	Rainfall	X								
A.2	Accident Effect Related	4.09	4.33	17.7	4.3	17.7	3	12.2	4	16.4
A.2.1	Population (DEM)	X								
A.2.2	Emergency Planning (DEM,LU,SOCEC)	X								
A.2.3	Atmospheric Dispersion (MET)	X								
A.3.1	Surface Water – Radionuclide Pathway	2.50	5	12.5	4	10	5	12.5	4	10
A.3.1.1	Dilution Capacity	X								
A.3.1.2	Baseline Loadings	X								
A.3.1.3	Proximity to Consumptive Users	X								
A.3.2	Groundwater Radionuclide Pathway (HYDRO&RAD)	2.55	5	12.7	4	10.1	2	5.1	5	12.7
A.3.3	Air Radionuclide Pathway (MET, RAD)	2.50	4	10	5	12.5	4	10	4	10
A.3.3.1	Topographic Effects	X								
A.3.3.2	Atmospheric Dispersion	X								
A.3.4	Air-Food Ingestion Pathway (MET,RAD &LU)	2.50	4	10	5	12.5	5	12.5	4	10
A.3.5	Surface Water-Food Radionuclide Pathway (HYDRO<RAD & LU)	2.41	4	9.6	5	12.1	5	12.1	4	9.6
A.3.6	Transportation Safety (MET,LU)	2.14	5	10.6	5	10.6	4	8.5	5	10.6

	Criteria	Weight	GGN	GGN	JAF	JAF	PNS	PNS	RBS	RBS
B.1.1	Disruption of Important Species/Habitats (ECOL)	2.64	5	13.2	3	7.9	2	5,7	5	13.2
B.1.2	Bottom Sediment Disruption Effects (HYDRO)	2.14	3	6.4	2	4.3	5	10.7	3	6.4
B.1.2.1	Contamination	X								
B.1.2.2	Grain Size	X								
B.2.1	Disruption of Important Species/Habitats and Wetlands	3.18	5	15.9	4	12.7	3	9.5	4	12.7

	Criteria	Weight	GGN	GGN	JAF	JAF	PNS	PNS	RBS	RBS
	(ECOL)									
B.2.1.1	Important Species/Habits	X								
B.2.1.2	Ground Cover/Habitat	X								
B.2.1.3	Wetlands	X								
B.2.2	Dewatering Effects on Adjacent Wetlands (ECOL)	2.77	5	13.8	4	11.1	3	8.32	5	13.8
B.2.2.1	Depth to Water Table	X								
B.2.2.2	Proximal Wetlands	X								
B.3.1	Thermal Discharge Effects (ECOL & HYDRO)	3.64	5	18.2	5	18.2	4	14.5	5	18.2
B.3.1.1	Migratory Species Effects	X								
B.3.1.2	Disruption of Important Species/Habitats	X								
B.3.1.3	Water Quality	X								
B.3.2	Entrainment/Impingement Effects (LU & HYDRO)	3.23	5	16.1	4	12.9	3	9.7	5	16.1
B.3.2.1	Entrainment Organisms	X								
B.3.3	Dredging/Disposal Effects (LU & HYDRO)	2.36	4	9.5	4	9.5	5	11.8	4	9.5
B.3.3.1	Upstream Contamination Sources	X								
B.3.3.2	Sedimentation Rates	X								
B.4.1	Drift Effects on Surrounding Areas (ECOL)	2.36	4	9.5	5	11.8	2	4.7	4	9.5
B.4.1.1	Important Species/Habitat Areas	X								
B.4.1.2	Source Water Suitability	X								
C.1.1	Socioeconomics – Construction – Related Effects (LU & SOCEC)	2.0	3	6	4	8	5	10	4	8
C.2.1	Socioeconomics – Operation	X								
C.3.1	Environmental Justice	1.95	5	9.8	5	9.8	5	9.8	5	9.8
C.4.1	Land Use	X								
C.4.1.1	Construction and Operation – Related Effects	X								
D.1.1	Water Supply (HYDRO)	3.70	3	11.1	4	14.8	3	11.1	4	14.8
D.1.2	Pumping Distance (ENG)	3.05	4	12.2	3	9.1	2	6.1	4	12.2
D.1.3	Flooding (HYDRO)	2.90	4	11.6	3	8.7	3	8.7	3	8.7
D.1.4	Vibratory Ground Motion (GEOL)	4.00	4	16	5	20	3	12	3	12
D.1.5	Soil Stability (GEOL)	3.40	3	10.2	4	13.6	3	10.2	3	10.2
D.1.6	Brownfield Site Remediation	X								
D.2.1	Railroad Access	2.60	3	7.8	3	7.8	2	5.2	3	7.8
D.2.2	Highway Access	2.80	3	8.4	3	8.4	3	8.4	3	8.4
D.2.3	Barge Access	2.85	3	8.5	3	8.5	3	8.5	3	8.5
D.2.4	Transmission	4.80	3.67	17.6	3.67	17.6	4.47	22.4	3	14.4
D.2.4.1	Transmission – Construction	X								
D.2.4.2	Transmission Losses	X								
D.2.4.3	Transmission Services Competition	X								
D.3.1	Topography (ENG)	2.55	4	10.2	4	10.2	3	7.65	4	10.2
D.3.2	Land Rights (LU)	2.75	3	8.25	3	8.25	3	8.25	3	8.25
D.3.3	Labor Rates (ENG-COST)	3.30	5	16.5	4	13.2	4	13.2	5	16.5
	Total			407		405		350		387

SECTION 2



ESP Site Selection Committee Meeting

September 6, 2001

ENTERGY NUCLEAR

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Table of Contents

- Agenda
- Early Site Permit “The Nuclear Option” Presentation
- “The Nuclear Stars are Aligning” Presentation
- “Entergy Nuclear Site Selection Criteria Guidelines for an Early Site Permit”
- Nuclear Option White Paper
- Integrated Schedule of New Plant Activities
- AP1000 Combined Operating License Plan
- AP1000 Schedule
- GT-MHR Roadmap
- 40 Year Sites

ESP Site Selection Committee Meeting
September 6, 2001
Entergy Power House Power Station #1

Agenda

0800 – 0830	Introduction to ESP Goals and Objectives	Kenneth Hughey
0830 – 0900	Introductions to PPE's	Jeff Richardson
0900 – 0945	Site Selection Guidelines	Mike Bourgeois
0945 – 1015	Geographic Information Systems	Bob West
1015 – 1030	Break	
1030 – 1100	Analysis of Federal Regulatory Changes	George Zinke
1100 – 1130	Public Support	Kelle Barfield
1130 – 1230	Lunch	
1230 – 1330	First Discussion Group – Lead Transmission Access Power Pricing	Dan Dormady (Tony Walz)
1330 –1345	Break	
1345 – 1445	Second Discussion Group – Lead Seismic Evaluation Exclusion Area Water Availability	Rick Buckley (Bob West)
1445 – 1500	Break	
1500 – 1530	Third Discussion Group – Lead Demographic Changes Emergency Planning	Mike Bourgeois (Curtley Hayes)
1530 – 1600	Forth Discussion Group – Lead Permitting / Licensing Status Plans for Existing Units Spent Fuel Storage	George Zinke
1600 – 1630	Initial Screening Decision Matrix Action	Mike Bourgeois

Early Site Permit

The Nuclear Option

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Phase Implementation

- Phase A - Site Selection
  - Step 1 Initial Screening (4 of 7)
  - Step 2 Site Selection (2 of 4)
- Phase B - ESP Development
- Phase C - ESP Review & Submittal
- Phase D - NRC Review & Approval

project to be completed in phases with project feasibility revisited between phases

Recommendations

- Complete Phase A this year (2001)
- Select Two Sites (done in parallel)
  - One in Southwest
  - One in Northeast
- Start with Entergy Controlled Site
- Use Certified Design Plant Assumptions (PPE)

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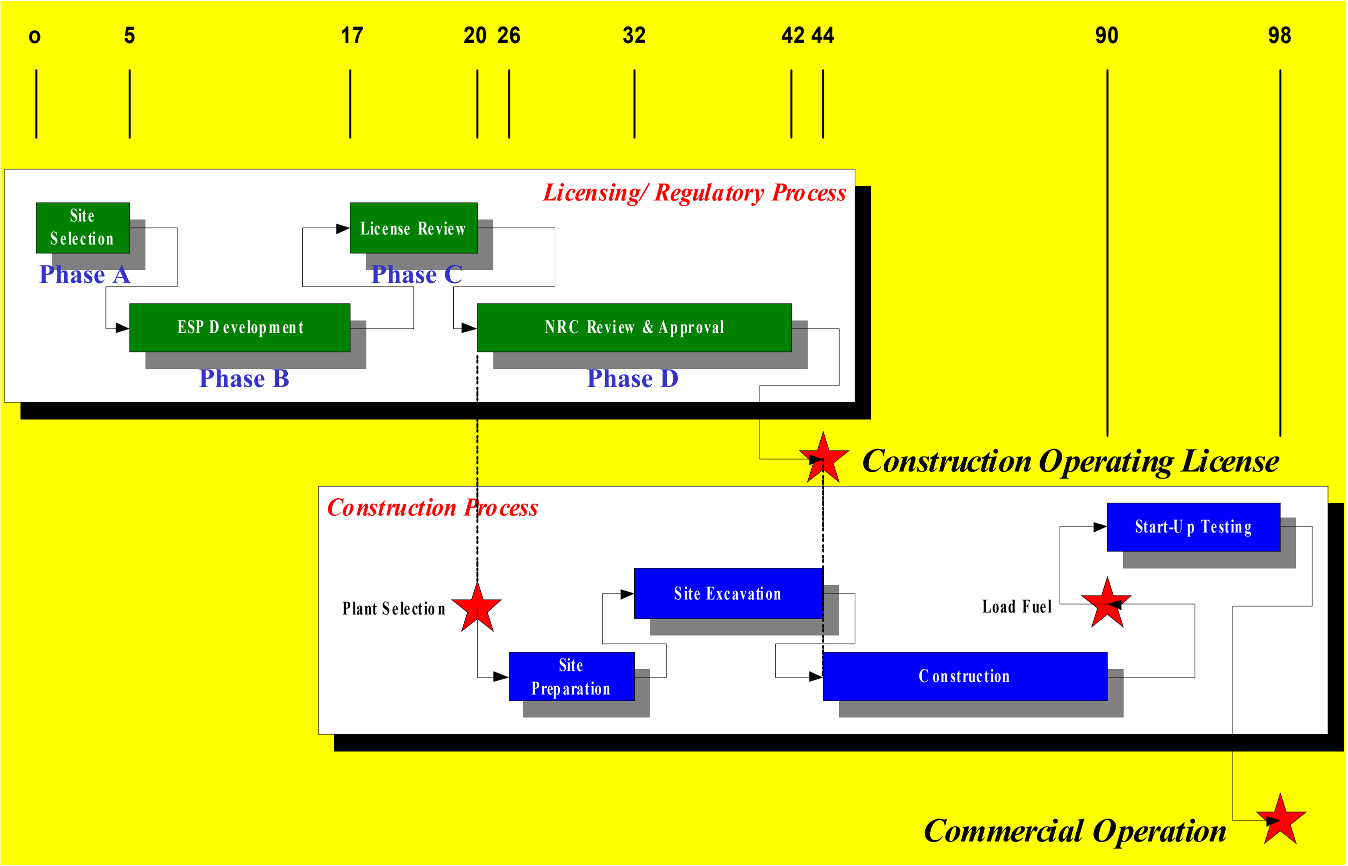
Months until a New Nuc on line



Type of Plant

- Certified Evolutionary LWR
  - ABWR
  - System 80 +
- Certified ALWR
  - AP 600
  - AP 1000
- Certified Generation IV
  - PBMR
  - GT-MHR
- Will use PPE

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Siting Evaluation

- Health and Safety
  - Accident Cause Related
  - Accident Effect Related
  - Operational Effect Related
- Environmental
  - Construction Effects on Aquatic Ecology
  - Construction Effects on Terrestrial Ecology
  - Operational Effects on Aquatic Ecology
  - Operational Effects on Terrestrial Ecology
- Socioeconomics
  - Construction Effects
  - Operation Effects
  - Environmental Justice
  - Land Use
- Engineering and Cost
  - Health and Safety
  - Transportation or transmission
  - Land use and Site Preparation

Criteria

- **Exclusionary Criteria**
  - used to eliminate areas based on consideration of go/no-go situations and are generally based on regulatory and plant design (PPE) requirements.
  - **Avoidance Criteria**
  - utilized to identify broad areas with more favorable than unfavorable conditions,m for example distance from population centers.
  - **Suitability Criteria**
  - requirements that affect the relative environmental suitability or cost of developing the site, but do not represent unacceptable environmental stress, severe licensing problems, or excessive additional cost.

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Factors for Existing Sites

- Seismic Evaluation
- Demographic Changes
- Emergency Planning
- Exclusion Area
- Transmission Access
- Power Pricing
- Water Availability
- Permitting / Licensing Status
- Plans for Existing Units
- Spent Fuel Storage

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EXAMPLE

Factors for Existing Site Evaluations

Factor		ANO	GGN	JAF	IP	PNS	RBS	W3	
Seismic Evaluation	1.1	M 2.2	H 3.3	H 3.3	X	M 2.2	M 2.2	M 2.2	A112,A113,A114,A115 M-some faults or water content
Demographic Changes	1.2	H 3.6	H 3.6	H 3.6	X	M 2.4	H 3.6	L 1.2	A21, X- >500/sq mi., L&M population density or population center
Emergency Planning	1	H 3	H 3	H 3	X	H 3	H 3	H 3	No problems identified by EP Directors north and south
Exclusion Area	.9	M 1.8	M 1.8	L .9	X	L .9	H 2.7	H 2.7	H->3000, M->1000, L->500 acres
Transmission Access	1.2	L 1.2	M 2.4	M 2.4	X	M 2.4	L 1.2	L 1.2	H->2000, M->1000, l-<1000 First Problem Fix Max Injection
Power Pricing	1.3	M 2.6	L 1.3	M 2.6	X	H 3.9	M 2.6	H 3.9	H=0-100, M=101-213, L= not rated (99 EWO siting study)
Water Availability	1	M 2	H 3	M 2	X	M 2	H 3	H 3	A121 & Siting Assumptions Study
Permitting / Licensing Status	.8	H 2.4	H 2.4	L .8	X	M 1.6	H 2.4	H 2.4	View of ease of state site permitting effort
Plans for Existing Units	.8	M 1.6	H 2.4	H 2.4	X	L .8	H 2.4	H 2.4	L-PNS license renewal project M-ANO2 license renewal project (ANO1 completed)
Spent Fuel Storage	.7	H 2.1	H 2.1	H 2.1	X	M 1.4	H 2.1	M 1.4	M- PNS smallest site area W3 cost of soil foundation for effort.

H=3, M=2, L=1
ANO=23, GGN=26, JAF=23, PNS=20, RBS=26, W3=24
ANO=22.5, GGN=25.3, JAF=23.1, PNS=20.6, RBS=25.2, W3=23.4

“The Nuclear Stars are Aligning” Presentation

(21 pages, Entergy Business Sensitive, not included)

"Entergy Nuclear Site Selection Criteria Guidelines for an Early Site Permit"

(30 pages)

Entergy Nuclear

Site Selection Criteria Guidelines

For An

Early Site Permits

Approved

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William K. Hughey
August 2001

I. General Siting Criteria

Public Involvement and Acceptance

Public involvement is a necessary and desirable part of the ESP site selection process and enables the applicant to consult with and include interested and affected individuals in the decision process. The public involvement process provide a means by which the public's questions and concerns (if they exist) can be identified in advance of decisions, so that those decisions consider and reflect the views of the public to the extent possible. The specific nature and timing of an applicants public involvement activities should be developed in concert with the siting plans.

1. Early Stage of siting – identification of broad candidate areas, primarily includes public information activities such as:
   - Providing regional medial releases and background reports periodically and at key decision points.
   - Informal networking (small meetings and briefings) with state and local officials, educational institutions, industry groups, media, and other opinion makers should be initiated to inform these organizations as to the overall intent of the process.

1. As avoidance and exclusionary criteria are being applied in this stage, it is important to continue preparation of general media releases to increase efforts to establish local and regional network of expertise.
   - Building communication channels with local and regional elected officials so that formal relationships are established before the announcement of candidate sites.
   - Identify other interested and affected parties that will need / want to be contacted immediately upon announcement of candidate sites.
   - Creating a technical review group (composed of local and regional technical experts from universities, planning commissions, consulting organizations) that can be used to verify the implementation of complex choices through the use of decision-aiding techniques.

1. As suitability criteria are being applied at this stage, key activities include:
   - Conduct community interviews to identify interested and affected parties and to identify membership for a potential community advisory group (e.g., composed of elected and appointed officials, and leaders of community, environmental, and neighborhood groups) that could provide useful input to the process and input that would be viewed as not necessarily influenced by the applicant's views.
   - Establish information repositories within each community that hosts a candidate site.
   - Conducting small meetings, workshops, and open house at the information repositories.
   - Organizing and supporting a speakers bureau composed of project staff members, and advisory and technical review group members, who would be trained to make presentations to local civic and community groups.
   - Arranging tours of and or visits from similar nuclear facilities for selected parties. Arrange for applicant staff, government personnel, and or private citizens to be available to answer questions.
   - Beyond activities associated with the community in which each candidate site is located, identifying and implementing communication mechanisms for surrounding communities commensurate with their interest and the impact of the site on their community.

1. At this Site-specific stage, the public participation process should become even more interactive and activities and programs should be tailored to the characteristics and features of the site.
   - Formally designating a site-specific advisory or working group
   - Tailoring the public participation plan to the site
   - Starting a site-specific newsletter, hotline, web site, and other communication devices.

VOLUNTEER SITE

A volunteer site is defined as one that is put forth by a government entity or private concern for purposes of being considered as the location for a potentially controversial facility. Previous experience with volunteer sites to the Early Site Permit Process suggests the following:

- Obtaining public acceptance at the earliest stage possible is always preferable.
- Any volunteer site must be subject to the rigors of the siting process and must be treated in an equivalent fashion to all other land units being considered. Volunteer sites must be capable of surviving NRC's "no obviously superior alternative site" test.
- The earlier in the application of the siting process that a volunteer site is identified and offered, the simpler will be its incorporation into the process from both operational and cost perspectives.
- For volunteer sites that are not owned by a governmental entity, a due diligence examination should be conducted so that the history and uses of the site are thoroughly understood.
- Any data that is provided in association with an offer of a volunteer site should be carefully and thoroughly reviewed for accuracy.
- If a site is volunteered, it will be critical to first understand the institutional framework under which the site is being offered as well as the views of other stakeholders.

Siting Criteria

A. Health and Safety
B. Environmental
C. Socioeconomics
D. Engineering and Cost

A. Health and Safety

1. Accident Cause Related
2. Accident Effect Related
3. Operational Effect Related

B. Environmental

1. Construction Effects on Aquatic Ecology
2. Construction Effects on Terrestrial Ecology
3. Operational Effects on Aquatic Ecology
4. Operational Effects on Terrestrial Ecology

C. Socioeconomics

1. Construction Effects
2. Operation Effects
3. Environmental Justice
4. Land use

D. Engineering and Cost

1. Health and Safety
2. Transportation or transmission

3. Land use and Site Preparation

Four Step Procedure

1. Establish a Region of Interest
2. Establish Candidate Areas
3. Establish Potential Sites
4. Establish Candidate Sites

Step	**1**	**2**	**3**	**4**
Starting point	Region of Interest	Candidate Areas	Potential Sites	Candidate Sites
Process	Area Screening	Area Screening	Site Screening	Site Screening: Issue by Issue Analysis
CRITERIA **E-Exclusionary** **A-Avoidance** **S-Suitability**	E & A	E & A	Principally S, Some redefinition of E&A Boundaries	Principally S
Result	Candidate Area	Potential Sites	Candidate Sites	Acceptable Sites or Preferred Sites
DATA Sources	Published 1:250,000	Published 1:125,000 to 1:24,000	Published and Reconnaissance 1:24,000	Detailed On-Site Verification Surveys 1:24,000 or Larger

Steps 1 & 2 are accomplished using mappable information and can be greatly facilitated by employing a computerized Geographic Information System (GIS) as the mechanism for managing information.

Steps 3 & 4, this portion of the process begins with the use of mapped and other published information and concludes with detailed information collected through on-site investigation, as necessary, culminating in the selection of a preferred site for which an ESP application can be submitted.

Criteria Types

Exclusionary Criteria – used to eliminate areas based on consideration of go/no-go situations and are generally based on regulatory and plant design (PPE) requirements.

Avoidance Criteria – utilized to identify broad areas with more favorable than unfavorable conditions, for example distance from population centers.

Suitability Criteria – requirements that affect the relative environmental suitability or cost of developing the site, but do not represent unacceptable environmental stress, severe licensing problems, or excessive additional cost.

A. Health and Safety

1. Accident Cause Related

		STEPS			
	Criteria	1	2	3	4
A.1.1	Geology/Seismology (GEOL)				
A.1.1.1	Vibratory Ground Motion	E	E	S	S
A.1.1.2	Capable Fault	E&A	E&A	S	S
A.1.1.3	Surface Faulting and Deformation	A	A	S	S
A.1.1.4	Geologic Hazards	A	A	S	S
A.1.1.5	Soil Stability		A	A&S	S
A.1.2	Cooling System Requirements				
A.1.2.1	Cooling Water Supply (HYDRO)	A	A	S	S
A.1.2.2	Ambient Temperature Requirements (MET)	E			
A.1.3	Flooding (HYDRO)	E	E	S	S
A.1.4	Nearby Hazardous Land Uses (LU,SOCEC)				
A.1.4.1	Existing Facilities		A	S	S
A.1.4.2	Projected Facilities			S	
A.1.5	Extreme Weather Conditions (MET)				
A.1.5.1	Winds	E&A		S	
A.1.5.2	Rainfall	E&A			

A.1.1.1 Vibratory Ground Motion – **Exclusionary Criteria** - Maximum Safe Shutdown Earthquake (SSE) of 0.30g, and the Probability of Exceedance of 2% in 50 years (once in 2500 years).

Maps: Developed by the USGS as part of the National Earthquake Hazards Reduction Program (Frankel, A. et al, National Seismic Hazard Maps, Documentation, June 1996, US Geological Survey Open File Report 96-532)

Suitability Criteria – While site specific investigation will be required to define the ultimate static and dynamic engineering properties of a particular site's soils, there are certain soil properties that, in association with vibratory ground motion, have unfavorable characteristics, such as high water table, grain size distribution, and low density. Sites with the highest values of Peek Ground Acceleration (PGA) in combination with deleterious site soils would receive a low rating.

Sites scoring highest should be evaluated using Reg. Guide 1.165.

A.1.1.2 Capable tectonic Structures or Sources – **Exclusionary Criteria** – no absolute exclusionary criteria have been identified.

Avoidance Criteria:

Distance from the Site (mi.)	Minimum Fault Length (mi.)
0 – 20	1
Greater than 20 to 50	5
Greater than 50 to 100	10
Greater than 100 to 150	20
Greater than 150 to 200	40

Suitability Criteria – If faults or other potentially capable structures were identified, an evaluation can provide preliminary ranking of candidate sites based upon the available data. Of particular concern is the orientation of any nearby fault or other structures, and the propagation characteristics of relevant earthquakes.

A.1.1.3 Surface Faulting and Deformation – **Avoidance Criteria** – Site locations that are within 25 miles of a tectonic structure that has exhibited, or has the potential to exhibit, surface displacement or deformation should be avoided.

Suitability Criteria –

I. Within 25 miles
- Any such structures altogether (best)
- Potential non-capable structures
- Potential capable structures (Least)

I. Within 5 miles
- Any such structures altogether (best)
- Potential non-capable structures
- Potential capable structures
- Fault exceeding 1,000 feet in length
- Capable fault exceeding 1000 feet in length (Least)

Appendix D Reg. Guide 1.165

A.1.1.4 Geologic Hazards – **Avoidance Criteria** – The following geologic and related man-made conditions should be avoided.
- Areas of active (and dormant) Volcanic activity
- Subsidence areas caused by withdrawal of subsurface fluids such as oil or groundwater, including areas which may be effected by future withdrawals.
- Potential unstable slope areas, including areas demonstrating palolandslide characteristics.
- Areas of potential collapse (e.g., karstic areas in limestone, salt, or other soluble formations)
- Mined areas, such as near-surface coal mined-out areas, as well as areas where resources are present and may be exploited in the future
- Areas subject to seismic and other induced water waves and floods

Suitability Criteria – Sites furthest away from these features would be best.

A.1.1.5 Soil Stability – **Avoidance criteria** –Areas with soils that might be unstable because of their mineralogy, lack of consolidation, water content, or potentially undesirable response to seismic or other events should also be avoided.

Suitability Criteria – Based on judgement and the nature of the soil properties characterizing the potential sites, the most suitable soils among the potential sites would be best.

A.1.2.1 Cooling Water Supply – **Avoidance Criteria** –The evaluation of water supply adequacy involves the comparison of (1) site supply characteristics associated with low-flow conditions as modified by other use allocations as projected into the period of plant operation with (2) the design basis plant water consumption rate. The US Geological Survey compiles data on the 7-day average low-flow for a recurrence interval of 10 years for streams and rivers throughout the United States.

PPE Section	Requirement	Composite Certified ALWR Value
2.7.15 2.8.18 2.10.10	Makeup Flow Rate (Closed Cycle Systems)	20,600(34,500) GPM

2.7.16 2.8.15 2.10.11	Maximum Consumption of Water (Closed Cycle System)	17,700 GPM
2.7.17 2.8.16 2.10.12	Monthly Average Consumption of Raw Water (Closed Cycle Systems)	15,400 GPM
2.9.2	Cooling Water Flow Rate (Once-Through)	1,100,000 GPM

Suitability Criteria – The potential sites should be evaluated and scored with regard to the degree with which the supply at low-flow conditions, based on 7-day, 10-year low flows and historical drought stages or water surface elevations, exceed the design basis consumption rate and the projected future use requirements. The potential effects of cooling water withdrawals on water quality will be evaluated on the basis of the likelihood of conflicts, based on minimum flow availability, in areas with existing or expected wastewater discharges or other potentially significant water quality constraints.

The supply exceedance value would form the basis. The highest degree of excess supply would be the best.

A.1.2.2 Ambient Temperature – **Exclusionary Criteria** – Areas that do not meet one or more of the PPE requirements below are to be excluded. Data for the analyses are generally available from National Oceanic and Atmospheric Administration (NOAA).

PPE Section	Requirement	Composite Certified ALWR Value
2.1.1	Normal Shutdown Max Ambient Temp (1% Exceed) Coincident	100 F DB/77 F WB
2.1.2	Normal Shutdown Max Wet Bulb Temp (1% Exceed) Non-coincident	80 F WB
2.1.3	Normal Shutdown Min Ambient Temp (1% Exceed)	-10 F
2.1.5	Rx Thermal Power Max Ambient Temp (1%Exceed)	115 F DB/80 F WB
2.1.6	Rx Thermal Power Max Wet Bulb Temp (0% Exceed) Non-coincident	81 F WB
2.1.7	Rx Thermal Power Min Ambient Temp (0% Exceed)	- 40 F
2.7.3 2.8.2 3.6.3	Approach Temperature	10 F

A.1.3 Flooding – **Exclusion Criteria** –PPE Section 1.8.1 requires that the maximum flood must be at least one foot below plant grade. Any areas incapable of meeting this standard should be excluded. 10 CFR 100 {20. (C)(3), 23. (d) (3)} and Reg. Guide 4.7 provide additional requirements/guidance regarding physical characteristics of site that shall be considered in the design and construction of any plant. Site parameters, such as, design basis flood conditions or tornado wind loading is established for use in evaluating a site. FEMA flood hazard maps can be used to exclude areas within the 100-year floodplain.

Suitability Criteria – Using FEMA flood hazard maps and related data on the elevation and areas associated with the 100 and 500-year flood levels, together with topographic information of the potential sites, develop a function related to the degree of exceedance of the 100-year flood level elevation on an areal percentage basis. Sites that have the highest degree of exceedance of flood level elevations would be best.

A.1.4.1 Existing Facilities – **Avoidance Criteria** –Avoidance areas lands within 10 miles of major airports or within 5 miles of hazardous facilities, including the following:

- Military bases, munitions storage areas and ordnance test ranges, missile bases, firing or bombing ranges
- Oil pipelines
- Oil or gas wells
- Oil and gas storage areas
- Significant manufacturing plants
- Chemical plants
- Refineries
- Mining and quarrying operations
- Dams
- Land and water Transportation routes for hazardous materials
- Docks and anchorage for hazardous materials

Suitability Criteria – For sites with hazardous facilities within the specified distance, confirm site suitability by conducting a detailed evaluation of the degree of risk imposed be each potential hazard. The acceptability of a site depends on establishing that:

- ➢ An accident at a nearby industrial, military, or transportation facility would not result in radiological consequences that exceed the dose specified in 1- CFR 50.34, or
- ➢ The accident poses no undue risk because it is sufficiently unlikely to occur (less than about 10^{-7} per year), or
- ➢ The nuclear power station can be designed so its safety will not be affected by the accident.

A.1.4.2 Projected Facilities – **Suitability Criteria** – Two considerations can form the basis for projecting the likelihood for future potentially hazardous facilities to be located within 5 miles of the plant. 1) Suitability and compatibility of land use plans and zoning and 2) projected economic growth related to the particular type of facility

A.1.5 Extreme Weather Conditions – **Exclusionary Criteria** - The following PPE sections and value define the extreme weather conditions of interest for site selection.

PPE Section	Requirements	Composite Certified ALWR Value
1.11	Tornado (Design Basis)	
1.11.1	Maximum Pressure Drop	1.46 PSID
1.11.2	Maximum Rotational Speed	240 MPH
1.11.3	Maximum Translational Speed	57 MPH
1.11.4	Maximum Wind Speed	260 MPH
1.11.6	Radius of Maximum Rotational Speed	150 FT
1.11.7	Rate of Pressure Drop	1.2 PSI/SEC
1.12	Wind	
1.12.1	Basic Wind Speed	110 MPH

1.12.2	Importance Factors	1.0 (NSR)/1.11 (SR)
1.4	Precipitation	
1.4.1	Maximum Rainfall Rate	19.4 in/hr (6.2 in/5 min)
1.4.2	Snow Load	50 lbs./sq. ft.

A.1.5.1 Winds – In addition to the above exclusionary extreme weather events considered in the development of PPE's extreme weather avoidance and suitability criteria can be developed form available meteorological data and studies.

Suitability Criteria – Sites where severe weather frequencies differ, the sites with lowest frequency for each identified event type would be the best.

A.1.5.2 Precipitation – Data and statistical studies and evaluations for extreme precipitation events are available from NOAA's National Climatic Data Center.

2. Accident Effects Related

	Criteria	1	2	3	4
A.2	Accident Effect Related				
A.2.1	Population (DEM)	E	E	S	S
A.2.2	Emergency Planning (DEM,LU,SOCEC)			S	S
A.2.3	Atmospheric Dispersion (MET)	E	E	S	

A.2.1 Population – **Exclusionary Criteria** – The proposed site meets the following conditions codified at 10 CFR 100.21

- An exclusion area surrounding the reactor in which the reactor licensee has the authority to determine all activities, including exclusion and removal of personnel and property,
- A Low population zone (LPZ) which immediately surrounds the exclusion area
- A population-center distance of at least 1.33 times the distance from the reactor to the outer boundary of the LPZ, where a populated center contains more than about 25000.
- Reg. Guide 4.7 – population density, including weighted transient population, averaged over any radial distance out to 20 miles does not exceed 500 persons per square mile.

Population Center Size	Exclusionary Distance (mi.)
25,000	4
100,000	10
500,000	20
1,000,000	30

Suitability Criteria – Sites with the lowest cumulative population density would be best.

A.2.2 Emergency Planning – **Suitability Criteria** - Sites with such emergency planning impediments, or with special population groups in the emergency planning zones, should be considered less suitable than sites that do not. Characteristics to be considered in this analysis include:

- Traffic Capacity
- Number of egress alternatives
- Network type: Freeway or expressway, urban streets, rural roads
- Number of traffic control points per network segment

- Terrain characteristics (curves, steep slopes)
- Climatic conditions.

A.2.3 Atmospheric Dispersion – **Exclusionary Criteria** – exclusionary criteria are provided for two distances and five accident averaging periods, the expected X/Q values can only be determined from hourly meteorological observations. In the absence of hourly observations, joint frequency distributions (JFD) of wind speed and directions by stability class can be used to develop surrogate X/Q values for use in identifying exclusionary and avoidance areas and evaluating site suitability.

PPE Section	Requirement	Composite Certified ALWR Value
9.1	Atmospheric Dispersion (X/Q) – Accident	
9.1.1	0.5mile, 0-2 hr.	1.0E-3 sec/m^3
9.1.2	2 mile, 0-8 hr.	1.35E-4 sec/m^3
9.1.3	2mile, 1-4 day	5.4E-5 sec/m^3
9.1.4	2 mile, 4-30 day	2.2E-5 sec/m^3
9.1.5	2 mile, 8-24 day	1.0E-4 sec/m^3

Suitability Criteria – Estimates of short-term X/Qs corresponding to the PPE values above would be developed for each of the candidate sites. This evaluation should also takes into account site-specific characteristics that could affect dispersion of accidental releases. Any sites whose estimated dispersion characteristics do not satisfy the PPEs would be eliminated from further consideration.

3. Operational Effects Related

	Criteria	1	2	3	4
A.3.1	Surface Water – Radionuclide Pathway				
A.3.1.1	Dilution Capacity			S	S
A.3.1.2	Baseline Loadings			S	S
A.3.1.3	Proximity to Consumptive Users			S	
A.3.2	Groundwater Radionuclide Pathway (HYDRO&RAD)	A	A	S	S
A.3.3	Air Radionuclide Pathway (MET, RAD)				
A.3.3.1	Topographic Effects			S	S
A.3.3.2	Atmospheric Dispersion	E	E	S	
A.3.4	Air-Food Ingestion Pathway (MET,RAD &LU)			S	
A.3.5	Surface Water-Food Radionuclide Pathway (HYDRO<RAD & LU)			S	S
A.3.6	Transportation Safety (MET,LU)			S	

A.3.1.1 Dilution Capacity – **Suitability Criteria** – The EPA employs the Probabilistic Dilution Model as an analytical tool, in the screening of "Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)" sites, to determine which sites have the potential to cause unacceptable health risks to downstream users and would thus require a detailed environmental fate analysis.

A.3.1.2 Baseline Loading – **Suitability Criteria** – Using data collected and reported by the USGS, the variation in radionuclide loading to streams can be evaluated for the potential sites. Where such data is not available for the potential sites, the upstream radionuclide discharge data from state and federal discharge permit information can be utilized to estimate pollutant loads from upstream sources.

A.3.1.3 Proximity to Comsumptive Users – **Suitability Criteria** – Identify the downstream locations of public water supply withdrawals and recreational contact uses and develop a combined utility function related to the distance to these uses.

A.3.2 Groundwater Radionuclide Pathway – **Avoidance Criteria** – The EPA issued its Groundwater Protection Strategy and provided Guidance for Groundwater Classification under its responsibilities as outlined in the SDWA. The Strategy established three general classes of ground water representing a hierarchy of groundwater resource values to society as follows:

- Class I – Special groundwater
- Class II – Groundwater currently and potentially a source of drinking water
- Class III – Groundwater not a source of drinking water

Class I ground waters are resources of unusually high value. They are highly vulnerable to contamination and are (1) irreplaceable sources of drinking water and (2) ecologically vital. Avoid areas of Class I ground waters.

Suitability Criteria – Within 2 miles of the potential sites, measure the percentage of Class II and Class III groundwaters.

Evaluate the groundwater within two miles of the site. The EPA has developed a numerical ranking system called DRASTIC, using readily available information on the following seven hydrogeologic characteristics to evaluate vulnerability:

- D – Depth to the water table
- R – Net Recharge
- A – Aquifer media
- S – Soil media
- T - Topography
- I – Impact on the vadose Zone
- C – Hydraulic conductivity of the subject ground-water flow system

A.3.3.1 Topographic Effects – **Suitability Criteria** – Significant topographic features involving significant local meteorological effects, resulting in significant potential for fogging/icing impacts, and requiring extensive land preparation will make the site less suitable.

A.3.3.2 Atmospheric Dispersion – **Exclusionary Criteria** – The PPE section defining the dispersion meteorological envelope that must be satisfied for successful ALWR siting is as follows

PPE Section	Requirement	Composite Certified Plant Value
9.2	Atmospheric Dispersion (X/Q) – (Annual Average)	0.5 mile 7.2E-5/ 1.0 mile 1.5E-5 sec/M^3

The dispersion parameter used to evaluate and distinguish exclusionary and avoidance areas and, where possible, suitability criteria is an estimated ambient concentration normalized by the emission rate. Reg. Guide 1.111 provides guidance on the appropriate dispersion model to use in this assessment.

Suitability Criteria – Develop annual average X/Q estimates for each potential site. The site with the lowest X/Q is the best.

A.3.4 Air-Food Ingestion Pathway – **Suitability Criteria** – The amount of crop and pasturelands in the areas surrounding potential sites would be determined and used to develop a function related to the potential for impacts via the air-food pathway. Measure (1) 0 to 10 miles; (2) 10 to 20 miles; (3) 20 to 30 miles. The acreage would be weighted on a graduated scale with the nearer areas receiving a greater emphasis.

A.3.5 Surface Water – Food Radionuclide Pathway – **Suitability Criteria** - In addition to the potential pathways addressed in A.3.1 Surface Water, and A.3.2 Groundwater Radionuclide Pathway, use of irrigation waters in downstream areas is a potential pathway for radionuclides.

Potential sites would be evaluated based on the proximity in the downstream direction to stream withdrawal locations and the acreage of the irrigation usage.

A.3.6 Transportation Safety – **Suitability Criteria** – Cooling systems operation could increase fogging or icing occurrences in the plant area or increase the intensity of naturally occurring fogging or icing events. Sites with greater potential for naturally-occurring fogging and icing conditions will generally be more likely be affected by plant cooling systems operations. Therefore, regions, areas, and sites with greater historical frequency of fogging and icing conditions will be less suitable for plant development.

B. Environmental

1. Construction Effects on Aquatic Ecology

	Criteria	1	2	3	4
B.1.1	Disruption of Important Species/Habitats (ECOL)	E	A	S	S
B.1.2	Bottom Sediment Disruption Effects (HYDRO)	[redacted]	[redacted]	[redacted]	[redacted]
B.1.2.1	Contamination	[redacted]	[redacted]	S	S
B.1.2.2	Grain Size	[redacted]	[redacted]	S	S

B.1.1 Disruption of Important Species/Habitats – Reg. Guide 4.7 defines important species as follows: A species, whether animal or plant, is important (for the purpose of this guide) if a specific causal link can be identified between the nuclear power station and the species and if one or more of the following criteria applies:

1. If the species is commercially or recreationally valuable,
2. If the species is endangered or threatened,

3. If the species affects the well being of some important species within criteria (1) or (2) or if it is critical to the structure and function of a valuable ecological system or is a biological indicator of radionuclides in the environment.

Of particular concern are the following habitat areas that are utilized by the significant important species, including consideration of seasonal use.

- Breeding and nursing
- Nesting and spawning
- Wintering, and
- Feeding

Exclusionary Criteria – Designated Critical habitats of endangered species
Avoidance Criteria – Avoid sites where threatened or endangered species are known to be present.
Suitability Criteria – Evaluate the remaining sites for presence of important species habitats such as marine grasses, commercial shellfish beds, spawning, nursing, and feeding areas. Sites where no potential impact is expected is best.

B.1.2 Bottom Sediment Disruption Effects – Potential short-term impacts to aquatic resources may occur as a result of dredging and related operations that disturb bottom sediments. Two considerations can be used to evaluate the degree of impact, which might occur from the activities.

B.1.2.1 Contamination – **Suitability Criteria** – Using data compiled by EPA, NOAA, and state agencies as part of EPA's Contaminated Sediment Strategy, the level of sediment contamination for areas within the potential sites where dredging may occur would be identified.

B.1.2.2 Grain Size **– Suitability Criteria** – The range of sediment grain sizes for the potential sites would be identified. Potential data sources include the USGS stream database, state publications, and NOAA studies. Sites with the lowest percentages of silt and clay would be the best.

2. Construction Related Effects on Terrestrial Ecology

	Criteria	1	2	3	4
B.2.1	Disruption of Important Species/Habitats and Wetlands (ECOL)				
B.2.1.1	Important Species/Habits			S	S
B.2.1.2	Ground Cover/Habitat			S	S
B.2.1.3	Wetlands	E	E	S	S
B.2.2	Dewatering Effects on Adjacent Wetlands (ECOL)				
B.2.2.1	Depth to Water Table			A&S	S
B.2.2.2	Proximal Wetlands			S	S

B.2.1.1 Important Species / Habitats – **Suitability Criteria** – A score of 5 would be assigned to sites that are outside the known range of important species. A score of 4 would be assigned to sites within the known range of important species but where no suitable habitat is present. A score of 3 would be assigned to sites within the known range of important species, where suitable habitat is present, but where no sightings have been recorded. A score of 2 would be assigned to sites within the known range of important species, where suitable habitat is present, and where there are reports of such species in transit through the area. A score of 1 would be assigned to sites within the known range of important species and where there are reports of the species present in the general area.

B.2.1.2 Ground cover / Habitat – **Suitability Criteria** – Two factors, consisting of the ecological value and acreage of each ground cover type covering the site, would serve as a surrogate for the impact that construction would have on terrestrial ecology.

- Ecological Value. The potential sites identified would be scored according to the ecological value of the ground cover present. The ecological value of each habitat type is dependent on several factors, including type of vegetation, the successional stage, the uniqueness of the flora and fauna, and the ecological function.

- Acreage of Ground Cover Covering Site. For each of the potential sites, the acreage of each habitat type/ground cover would be determined. An overall weighted average score for each site would be determined based on the value category score weighted by its acreage, summed over the whole site. The lowest weighted average score is best.

B.2.1.3 Wetlands – **Exclusionary Criteria** – Applicants should note that Executive Order, E.O. 11990, "Protection of Wetlands". This requires that each federal agency, "avoid to the extent possible the long and short term adverse impacts associated with the destruction or modification of wetlands, and to avoid direct or indirect support of new construction in wetlands wherever there is a practicable alternative…"

Suitability Criteria – A site with no or minimal wetlands of value is best.

B.2.2.1 Depth to Water Table – **Avoidance Criteria** – Areas with groundwater less than two feet below grade should be avoided. Initial screening can be conducted by using an environmental data base such as DENIX (Department of Defense Environmental Network and Information exchange) and SCS maps.

Suitability Criteria – Sites where the maximum depth to the water table occurs are best.

B2.2.2 Proximal Wetlands – **Suitability Criteria** –Score the potential sites according to their relative proximity to wetlands. Areas farthest away from wetlands would be the best.

3. Operational Effects on Aquatic Ecology

	Criteria	1	2	3	4
B.3.1	Thermal Discharge Effects (ECOL & HYDRO)	[redacted]	[redacted]		
B.3.1.1	Migratory Species Effects	[redacted]	[redacted]	S	S
B.3.1.2	Disruption of Important Species/Habitats	[redacted]	[redacted]	S	S
B.3.1.3	Water Quality	[redacted]	[redacted]	S	S
B.3.2	Entrainment/Impingement Effects (LU & HYDRO)	[redacted]	[redacted]		
B.3.2.1	Entrainment Organisms	[redacted]	[redacted]	S	S
B.3.3	Dredging/Disposal Effects (LU & HYDRO)	[redacted]	[redacted]		
B.3.3.1	Upstream Contamination Sources	[redacted]	[redacted]	S	S
B.3.3.2	Sedimentation Rates	[redacted]	[redacted]	S	S

B.3.1.1 Migratory Species Effects – **Suitability Criteria** – The Migratory Bird Treaty Act makes it unlawful to pursue, take, or kill migratory birds or the nest or eggs of such birds. The Bald and Golden Eagle Protection Act makes it unlawful to pursue, molest, or disturb bald and golden eagles, their nests, or their eggs in the US. Golden eagle nests that interfere with resource development or recovery operations may be relocated, if a permit is obtained from the US Department of Interior.

Four Factors will determine the effect that a thermal discharge will have on migratory species.

- Stream Capacity Flow. High flows would be the best.
- Width of the Stream. Sites with the largest widths would be the best.
- Size of Ponds or Lakes. Sites with the largest size (volume) would be the best.
- Species Abundance. Sites with a small numbers of migratory species would be the best.

B.3.1.2 Disruption of Important Species / Habitats – **Suitability Criteria** – Following the methods and considerations outlined in B.1.1 based on the potential effects on these resources, beyond those identified due to construction, which may result from operational activities.

B.3.1.3 Water Quality – **Suitability Criteria** – PPE's bound the chemical, thermal and flow characteristics of blowdown from ALWR cooling systems.

PPE Section	Requirements	Composite Certified ALWR Value
2.7.4 2.8.3 2.10.2 3.6.4 3.8.2	Blowdown Constituents and Concentrations	See Table
2.7.5 2.10.3	Blowdown Flow Rate (Mechanical Draft & Pond)	5,200 (17,700) GPM
2.8.4	Blowdown Flow Rate (Natural Draft)	5,200 (17,700) GPM
2.7.7 2.8.5 2.10.4	Blowdown Temperature (Closed Cycle)	100F
2.7.9 2.8.8 2.10.7	Cycles of Concentration (Closed Cycle)	4
2.9.1	Cooling Water Discharge Temp (Once-through)	118F
2.9.3	Cooling Water Temperature Rise (Once-through)	18F
2.9.5	Heat Rejection Rate	9.7E9 BTU/hr

	Concentration		
Constituent	**River Source**	**Well/Treated Water**	**Envelope**
Chlorine demand	10.1	--	10.1
Free available chlorine	0.5	--	0.5
Chromium	--	--	--
Copper	--	6	6
Iron	0.9	3.5	3.5
Zinc	--	0.6	0.6
Phosphate	--	7.2	7.2
Sulfate	599	3,500	3,500
Oil and grease	--	--	--
Total dissolved solids	--	17,000	--
Total suspended solids	49.5	150	150
BOD, 5-day	--	--	--

Factors should be considered in determining the effect that thermal discharges will have on overall water quality: baseline thermal loading, baseline ambient water temperature, expected stream flow rate, stream width, the sensitivity of the species present, and baseline concentration of dissolved oxygen, dissolved solids, and nutrients.

B.3.2.1 Entrainable Organisms – **Suitability Criteria** – Score the potential sites according to the expected density of potentially entrainable organisms such as phytoplankton and zooplankton. Particular emphasis should be given to the possibility of high seasonal densities of significant zooplankton species.

B.3.3.1 Upstream Contamination Sources **– Suitability Criteria** – Score the potential sites according to the amount of contamination that is released from facilities upstream. Low potential for upstream contamination sources is best.

B.3.3.2 Sedimentation Rates – **Suitability Criteria** – An assessment will be made on the range of sedimentation rates for each of the potential sites for areas, which may require maintenance dredging around intake structures. Low sedimentation rates is best.

4. Operational Effects on Terrestrial Ecology

B.4.1	Drift Effects on Surrounding Areas (ECOL)	[redacted]	[redacted]	[redacted]	[redacted]
B.4.1.1	Important Species/Habitat Areas	[redacted]	[redacted]	S	S
B.4.1.2	Source Water Suitability	[redacted]	[redacted]	S	S

B.4.1.1 Important Species / Habitat Areas – **Suitability Criteria** – Areas within 10 miles of the site where habitats of important species or habitats of high ecological value occur (including wetland areas) would be mapped based on 2, 4, 6, 8, 10 mile annuli. The acreage of these important habitats within each annulus would be measured and weighted as a function of distance to provide an overall distance-weighted measure of nearby important habitats. That weighted acreage of important habitats with low values is best.

B.4.1.2 Source Water Suitability – **Suitability Criteria** – Several factors should be considered in evaluating the magnitude of the potential drift effects as a result of variations in the chemical character of source water. Such factors vary regionally and include evaporation rate and concentrations of dissolved solids. Using data characterizing the potential concentrations of dissolved solids for various potential water sources, score the potential sites according to the expected magnitude of the potential impacts to water quality from cooling tower drift. Sites with lowest levels of dissolved solids and evaporation rate are best.

C. Socioeconomics

1. Construction Effects

	Criteria	1	2	3	4
C.1.1	Socioeconomics – Construction – Related Effects (LU & SOCEC)	[redacted]	[redacted]	S	S

C.1.1 Socioeconomics – Construction Related Effects – **Suitability Criteria** – PPE criterion for the construction work force requirement. PPE 29.4.1, Plant workforce – construction, 2600-6410 people.

The construction of a nuclear power plant is very labor-intensive. For the ALWR, skilled and unskilled construction workers would likely be needed over a 4 to 5 year period. Socioeconomic impacts of nuclear power plant construction are directly related to two factors.

- The number of construction workers who will move into the plant site vicinity with their families
- The capacity of the communities surrounding the plant site to absorb this new population.

From a socioeconomic perspective, the information that should be considered in rating sites from the perspective of construction impacts includes:

- Labor requirements
- Location of labor pool

- Number of immigrants
- Fiscal assessment of affected communities

It is important to understand the inverse interrelationship among socioeconomic impacts and health and safety / emergency planning criteria. From a socioeconomic perspective, proximity of a plant site to a major urban center is advantageous in terms of finding an adequate labor supply. However, from a health and safety concern, a large population is the plant vicinity results in greater public health and safety concerns.

The suitability analysis include
- Availability of an adequate labor force within commuting distance
- The ability of the community to absorb the influx of workers should they relocate.

Potential sites with an adequate labor force within a reasonable commuting distance would be the best.

2. Operation Effects

	Criteria	1	2	3	4
C.2.1	Socioeconomics – Operation				S

C.2.1 Socioeconomics – Operations – **Suitability Criteria** – Applicants who identify significant site-specific community benefits may wish to allow such factors to be taken into account in identifying a preferred site.

3. Environmental Justice

	Criteria	1	2	3	4
C.3.1	Environmental Justice			S	S

C.3.1 Environmental Justice - **Suitability Criteria** – With respect to environmental justice, the evaluation is a two-step process. The first step is to identify whether any minority and low-income populations exist that may be impacted by nuclear power plant construction and operation. The area to be evaluated for such populations would coincide with the area within a 50-mile radius of the site. If any minority or low-population groups are identified, the second step is to assess the degree to which each minority or low-income population would disproportionately experience adverse human and environmental impacts and would disproportionately be deprived of benefits. Guidelines for specific information requirements for environmental justice determinations are described in Attachment 4 to NRR Office Letter No. 906, Revision 1: "Procedural Guidance for Preparing Environmental Assessments and Considering Environmental Issues"

4. Land use

	Criteria	1	2	3	4
C.4.1	Land Use				
C.4.1.1	Construction and Operation – Related Effects	E	E&A	S	S

C.4.1.1 Construction and Operation – Related Effects – **Exclusionary Criteria** - Identify land use areas that are protected by a Federal, state, or local agency; to the degree feasible, proposed public amenity areas should also be identified. Reg. Guide 4.7 (Section B) identifies the areas of public use that should be considered along with the cognizant Federal agency. State's agencies should be contacted to identify similarly protected land uses at the state level.

Typical protected land uses important at this stage include, but are not limited to:

- National Parks
- Wild and Scenic Rivers
- Designated coastal-zone areas
- Wildlife Refuges
- Wilderness Areas
- Native American Reservations
- National Recreation Areas
- National Forests
- National Wildlife Reserves or Preserves
- National Recreation Areas
- National Historic Landmarks or Monuments
- National Trails

Avoidance Criteria – Individual states and local governments administer parks, recreation areas, and other public use and benefit areas. Information on these areas should also be obtained from cognizant state agencies. Consider the following land uses as avoidance or exclusionary areas.

- Hospitals
- Correctional facilities
- Schools
- Prime agricultural lands
- Historic, Cultural, and Archaeological sites.
- Commercially exploitable mineral resources
- Transportation and utility corridors
- Recreational areas (e.g., golf courses, swimming, fishing, boating)
- Designated visually sensitive areas or viewsheds.

Suitability Criteria – For each factor listed below, the applicant should establish distances from the site to which the listed features will be evaluated, based on the potential for impacts.

- Proximity to Designated Amenity Areas.
- Land Use Compatibility – Perform an evaluation of the number of acres of alternative land uses (e.g., prime farmland) that would be pre-empted by a nuclear power plant site and its support facilities (including substations, transmission lines, pipelines, roads, and railroads).
- Consistency with Land Use Plans
- Potential for Visual Impacts – Sites would be evaluated on the basis of the number of viewsheds from public amenity areas or other sensitive areas form which the nuclear power plant could be seen.

D. Engineering and Cost

1. Health and Safety

	Criteria	1	2	3	4
D.1.1	Water Supply (HYDRO)	[redacted]	[redacted]	S	S
D.1.2	Pumping Distance (ENG)	A	A	S	S
D.1.3	Flooding (HYDRO)	[redacted]	[redacted]	S	S
D.1.4	Vibratory Ground Motion (GEOL)	[redacted]	[redacted]	[redacted]	[redacted]
D.1.5	Soil Stability (GEOL)	[redacted]	[redacted]	S	S
D.1.6	Brownfield Site Remediation	[redacted]	[redacted]	S	S

D.1.1 Water Supply – **Suitability Criteria** – The analysis addresses the costs associated with supplying the plant water requirements, in light of future, competitive, non-plant consumption rates. PPE sections identify maximum and monthly average consumption of raw water. Cost estimates should be derived based on the cost of purchasing water for each site. Estimates should consider any additional costs associated with meeting plant requirements during low-flow periods or droughts that could reasonably be estimated from historical information.

D.1.2 Pumping Distance – **Avoidance Criteria** – Areas beyond a practical pumping distance would be mapped as avoidance areas. For example, a maximum distance of 20 miles from the water source or 20 miles upstream from the point of required minimum flow.

Suitability Criteria – the cost of constructing pumping stations and infrastructure developments necessary to transport water from the source to the site would be estimated.

D.1.3 Flooding – **Suitability Criteria –** The analysis for this criterion involves estimating the cost of additional engineered features that are required for flood protection. Also included would be any additional flood insurance costs associated with a floodplain.

D.1.5 Soil Stability **– Suitability Criteria** – The applicant should estimate the cost of site-specific foundation design features and associated construction requirements that might arise from soil conditions. Site preparation costs arising from topographic features are considered in D.1.3

D.1.6 Brownfield Site Remediation – **Suitability Criteria** – The purpose of this criterion is to capture costs associated with any environmental cleanup activities, that may be required at brownfield sites before they can be utilized for a nuclear power plant.

1. Transportation or transmission

PPE Section	Requirement	Composite Certified ALWR Value
29.1.1	Construction Module Dimensions	22(H)x21(W)x67(L)
29.1.2	Heaviest Construction Shipment	1,546,000 lbs.

Confirm that access routes capable of accommodating these requirements (either under existing conditions or with appropriate improvements) are available. Any sites that fail this review should be excluded from further consideration. Applicable to D.2.1, D.2.2, D.2.3.

	Criteria	1	2	3	4
D.2.1	Railroad Access	E		S	S
D.2.2	Highway Access	E		S	S
D.2.3	Barge Access	E		S	S
D.2.4	Transmission				
D.2.4.1	Transmission – Construction			S	
D.2.4.2	Transmission Losses			S	S
D.2.4.3	Transmission Services Competition			S	S

D.2.1 Railroad Access **– Suitability Criteria** – The cost of constructing a railroad spur from the nearest access location to the site boundary would be estimated, given site condition as revealed in USGS topographic and related land use maps.

D.2.2 Highway Access – **Suitability Criteria** - – The cost of constructing a road from the nearest access location to the site boundary would be estimated, given site condition as revealed in USGS topographic and related land use maps.

D.2.3 Barge Access **– Suitability Criteria** – There are two components of this cost evaluation. The first is an estimate of the cost of constructing a barge terminal. This estimate would include all costs attendant to the barge facility including land and port acquisition or leasing costs, relocation costs, dredging costs, and costs associated with infrastructure development at the barge location. Estimating the cost of any additional road or railroad development necessary to provide access from the barge terminal to the site derives the second component.

D.2.4.1 Transmission Construction – **Suitability Criteria** – Estimate the total miles of transmission line required to connect each site to the existing transmission grid, by line voltage.

D.2.4.2 Transmission Losses – **Suitability Criteria** – The cost of transmission losses may vary significantly between sites, depending on the relative location of the generating unit and the load center it serves. Applicants should take several factors into account in determining if and how this criterion is applied. Regulated utilities with defined service areas can predict load center location and demands with some confidence. In contrast, in a deregulated environment, power from an individual unit will be sold at market prices to buyers who may no be geographically located within the ROI and who may change over the life of the plant.

D.2.4.3 Transmission Services Competition **– Suitability Criteria** – Deregulation can result in the unbundling of power generation and transmission functions. By creating the possibility of competition, sites that provide multiple opportunities for selecting a transmission supplier may have significant economic benefits over those that will be captive to a single supplier.

3. Land use and Site Preparation

	Criteria	1	2	3	4
D.3.1	Topography (ENG)	E	A	S	S
D.3.2	Land Rights (LU)	[redacted]	[redacted]	S	S
D.3.3	Labor Rates (ENG-COST)	[redacted]	[redacted]	S	S

D.3.1 Topography – **Exclusionary Criteria** – Large areas characterized by mountainous terrain would be mapped as exclusion areas because of the excessive relief.

Avoidance Criteria – Areas with slopes greater than 12% mean slope, or greater than 400 feet relief within the minimum site area, would be mapped as avoidance areas.

Suitability Criteria – The intent of this criterion is to establish the costs associated with any topographic features that would translate into site-specific differences in site preparation costs.

D.3.2 Land Rights – **Suitability Criteria** – This criterion provides for an estimate of the cost of acquiring the necessary land area and buffer zones; it would include any costs of relocating existing site structures or facilities. In addition, for brownfield sites, costs that would arise from performing due diligence and any attendant regulatory-mandated cleanup activities should also be considered.

D.3.3 Labor Rates **– Suitability Criteria** – The intent of this criterion is to quantify any local labor conditions that might translate into cost differentials between sites. The labor pool of interest is that associated with plant construction.

II. Existing Nuclear Plant Sites and Brownfield

Site Type	Description	Siting Considerations
New / "Greenfield"	Undeveloped sites that were not used previously for any industrial purpose	No history of legacy contamination. No previous NRC approval; limited site characterization data available.
Existing	Sites that have received a previous formal approval from the NRC as a nuclear power plant site, including sites that: ➢ Are contiguous with operating nuclear power plant sites. ➢ Have previously received a construction permit and operating license (whether or not the construction permit or operating license has expired)	Previously approved by NRC as being a site for which no "obviously superior" alternative exists. A wealth of site characterization data exists.
Brownfield	Sites that have previously been the location of industrial facilities (either privately or publicly owned).	Legacy contamination may exist, with associated cleanup liabilities and costs.

1. Existing Sites

By virtue of the fact that they have been previously shown to be favorable sites in NRC licensing action, existing sites present attractive opportunities for Early Site Permits. In addition to enjoying acceptance by the local population, existing sites also posses a wealth of site data that will support both the ESP and Future COL action.

The ESP applicant must fulfill obligations under NEPA and as such, cannot limit site screening to only existing sites.

NRC recognition of existing site status is found in the fact that the agency has noted that a full-scale, systematic siting process may not be necessary to justify selection of an existing site for an ESP.

> "Recognize that there will be special cases in which the proposed site was not selected on the basis of a systematic site-selection process. Examples include plants proposed to be constructed on the site of an existing nuclear power plant previously found acceptable on the basis of a NEPA review and/or demonstrated to be environmentally satisfactory on the basis of operating experience.."

The streamline approach described in this section for satisfying the NEPA alternative site requirements is designed to take full advantage of existing sites as just such a special case. The two-phases of this process are:

- ➢ Ensure development of an ESP at the existing site will not pose technical, regulatory, or institutional risks for the existing nuclear power plant; such risks might derive from changes in regulatory requirements or site conditions (e.g., seismic evaluation, population growth, water availability), and (assuming no unacceptable risks are identified)
- ➢ Using the criteria in section I as a "suitability framework". Demonstrate that no other site in the surrounding region is "obviously superior" to the existing nuclear power plant site.

Phase 1 – Evaluate Site Licensing Risks and Suitability Issues

The objective of this step is to identify any potential negative impacts on the "apparent" suitability of the existing site, when judged against current standards and conditions. Because of the proprietary nature of issues being considered, Phase 1 evaluation should be conducted internal to the applicant's organization and would not become part of the ESP application itself.

Factors for Existing Site Evaluations

Factor	**Description**
Seismic Evaluation	Seismic design of the existing units should be evaluated against seismic reactor site criteria in 10 CFR 100, Appendix B, and the earthquake engineering criteria in 10 CFR 50, Appendix S. Since these criteria differ from those in effect when the current fleet of nuclear power plants was licensed, situations could arise where new plants must be designed to more stringent seismic criteria than existing operating plants. Because the new requirements are applicable only for application filed on or after January 10, 1997, they have no direct regulatory impact on existing plants. However, there is a risk that opponents would use such information to allege that the operating plants are "unsafe" because they do not meet current requirements. Such potentialities may not discourage from seeking ESPs at existing sites, but, in any case, they should be aware of this issue prior to proceeding with a new ESP application.
Demographic Changes	Because population distributions have changed markedly since the current fleet of nuclear plants was licensed, an existing site should be evaluated against both new commercial / residential patterns and NRC's current demographic site suitability guidance. These considerations are described in Regulatory Guide 4.7 Appendix A, Item A.4 as: 20-mile population density less that 500 persons/square mile; distance from LPZ boundary to nearest population center (>25,000) at least 1 1/3 times the distance from reactor to LPZ boundary. Population growth near the existing site may affect the ability of existing units to meet these criteria. Although regulatory compliance for existing plants would not be affected, the same kinds of public concerns and institutional risks as listed for Seismic Evaluations, above, could apply.
Emergency Planning	Although maintaining conformance with emergency planning requirements is an ongoing process at operating nuclear plants, EP requirements applicable to any proposed new ESP should be reviewed in light of existing data and plans to ensure that no major new EP issues, for either the new application or existing units, would be raised by licensing a new site.
Exclusion Area	Applicants must ensure that there is adequate land area at the existing site so that an exclusion area can be established for the new unit(s) which satisfies the requirements of 10 CFR 100
Transmission Access	Applicants must be assured that adequate transmission capability is available to deliver power from both existing and new units to customers, and that transmission charges will allow delivered electricity to be competitive in the open marketplace. The existing site should be evaluated in accordance with Criterion D.2.4 to ensure that existing sites are not significantly less favorable than alternative locations from a transmission perspective. Existing sites with adequate transmission capacity for both existing and new units have significant advantages for the new ESP, because there will be no need to incur environmental impacts of constructing additional transmission lines.
Power Pricing	In a deregulated environment, electricity both existing and new units will depend on a complex mix of market factors (e.g, number, size and location of customers; pre-existing long term supply contracts; plant ownership) all of which may vary over time. Under some circumstances, further concentration

	of generating units at a single physical location may produce a local "oversupply" which could affect prices generators can obtain for the output of both new and existing units. While predicting price impacts years into the future is at best a speculative matter, applicants should evaluate such potential effects to minimize the possibility of being put at a pricing disadvantage because of the large concentration of generating capacity at a single location.
Water Availability	Applicants must ensure that adequate cooling or make-up is available form the water source, taking into account both existing and potential new units. Water supply availability and cost evaluation are described in criteria; these should be applied using total water requirements for existing and planned units as the basis for evaluation. Results of this analysis will identify whether significant constraints in water availability (which would affect all units at the site and could hamper operations in times of low flow) exist.
Permitting / Licensing Status	This factor is included to focus on any outstanding or problematic ongoing regulatory issues involving existing units that provide insights into potential problems facing approval of an ESP. For example, a history of regulatory concerns about discharges from the existing plant would point to potential problems in obtaining withdrawal or discharge permits for new units. In evaluating this factor, applicants should consider the full spectrum of interfaces with regulators and the public to ensure that the existing site does not carry institutional risk that could affect approval of an ESP.
Plans for Existing Units	Applicants should ensure that developing an ESP is consistent with plans for existing units. Issues such as license extension, major maintenance (e.g., steam generator replacement), and decommissioning should be considered to ensure that an ESP and future units would not interfere logistically or from a regulatory posture with these plans.
Spent Fuel Storage	Because it is not clear when a central spent fuel repository will be available, plant operators are providing on-site storage in the form of interim storage facilities. Land requirement analysis for an ESP should also take into account any additional space required providing interim spent fuel storage for both new and existing units. Any site-specific issues identified in recent NRC reviews of applications for on-site spent fuel storage facilities should also be examined for relevance to the ESP application.

Phase 2 – Demonstrate No Alternative Sites are "Obviously Superior"

Guidance on the approach for making the determination is provided in NUREG –1555, Section 9.3

"The review should also include the staff's independent comparison of alternative sites with the applicant's preferred site to determine if there are any alternatives sites that are environmentally preferable to the proposed site. When one or more environmentally preferable alternative sites are identified, the scope of the review should be extended, using benefit-cost techniques and other procedures to determine if any environmentally preferable site can be shown to be obviously superior to the applicant's proposed site."

Criteria described in Health and Safety Accident Effects A.2 and Operational Effects A.3 and Environmental Criteria B sections provide an objective framework for evaluating and ranking the environmental suitability of nuclear power plant sites. The suitability criteria of the respective criteria establish bases for objective comparison of the relative environmental suitability of alternative sites. These criteria can be used to establish, first, whether any sites in the Region Of Interest are environmentally preferable to the proposed location, and, if necessary, whether any of these alternatives constitute "obviously superior" sites. For each of the environmental criteria can be defined. Using the range of conditions extant in the ROI, the suitability ratings for the proposed site can be developed. If the proposed site is shown to be highly suitable for all of the environmental criteria and if there are no criteria for which it is highly unsuitable, it can be argued that no environmentally preferable site exists. Site comparison beyond this stage may not be necessary.

If the comparative suitability evaluation indicates that environmentally preferable sites do exist, economic, technological, and institutional factors must be compared in a benefit-cost evaluation among the alternative sites to determine whether one or more of the environmentally preferable sites is obviously superior. Given that there are environmentally preferable sites, it must be possible to identify advantages from the cost, technical, and institutional perspectives that favor the preferred site. The Engineering and Cost Related Criteria that are provided in Section D constitute an initial framework for this evaluation. Additional institutional constraints or opportunities are site-specific and must be identified by the applicant. In terms of the regulatory guidance for the obvious superiority determination, NRC list three component factors: facility costs; institutional constraints, as they affect site availability; and additional public concerns. The following guidance on demographic criteria for identifying obviously superior sites is also found in NUREG-01555, Section 9.3, Appendix B:

> "In terms of a review of demographic aspects of the site-selection process, the population density guidelines of Reg. Guide 4.7 have been interpreted by the staff in the following manner:
>
> - If, on balance, there are alternative sites of approximately equal merit regarding issues other than population density,
> - If the proposed site has a population density substantially greater than one of the alternative sites, and
> - If that density is in excess of stated Reg. Guide 4.7 values, there does exist a site obviously superior to the proposed site."

1. Brownfield Sites

Brownfield sites refer to sites that have been previously developed and utilized for some purpose other than a nuclear power plant. These sites may present opportunities for an ESP in that they are already disturbed ecologically and are typically characterized as industrial land use. To allow equitable comparison of brownfield sites with other alternatives in the siting process, the full import of dealing with environmental contamination, environmental compliance problems must be considered.

To include brownfield sites in the process, applicants must ensure that these potential problems do not present cost or schedule impediments that either preclude or hinder development of a nuclear power plant such that other sites would be obviously superior. Provision for including such costs in the site comparison is provided in Engineering and Cost Related Criteria section, however, applicants must also address cleanup schedules and uncertainties in light of the objectives of their ESP application.

Finally, applicants must ensure that any cleanup activities planned for brownfield site, once an ESP has been issued, are consistent with the allowed use of the licensed site as provided in 10 CFR 50.10 (e)(1). In such cases, a site redress plan may be required as part of the ESP application.

Exclusionary & Avoidance Check List

A. Health and Safety

1. Accident Cause Related

STEPS

	Criteria		ANO	GGN	JAF	IP	PNS	RBS	W3
A.1.1	Geology/Seismology (GEOL)								
A.1.1.1	Vibratory Ground Motion	E							
A.1.1.2	Capable Fault	E&A							
A.1.1.3	Surface Faulting and Deformation	A							
A.1.1.4	Geologic Hazards	A							
A.1.1.5	Soil Stability	A							
A.1.2	Cooling System Requirements								
A.1.2.1	Cooling Water Supply (HYDRO)	A							
A.1.2.2	Ambient Temperature Requirements (MET)	E							
A.1.3	Flooding (HYDRO)	E							
A.1.5	Extreme Weather Conditions (MET)								
A.1.5.1	Winds	E&A							
A.1.5.2	Rainfall	E&A							

2. Accident Effects Related

	Criteria		ANO	GGN	JAF	IP	PNS	RBS	W3
A.2	Accident Effect Related								
A.2.1	Population (DEM)	E							
A.2.3	Atmospheric Dispersion (MET)	E							

3. Operational Effects Related

	Criteria		ANO	GGN	JAF	IP	PNS	RBS	W3
A.3.2	Groundwater Radionuclide Pathway (HYDRO&RAD)	A							
A.3.3	Air Radionuclide Pathway (MET, RAD)								
A.3.3.2	Atmospheric Dispersion	E							

B. Environmental

1. Construction Effects on Aquatic Ecology

	Criteria		ANO	GGN	JAF	IP	PNS	RBS	W3
B.1.1	Disruption of Important Species/Habitats (ECOL)	E							

2. Construction Related Effects on Terrestrial Ecology

	Criteria		ANO	GGN	JAF	IP	PNS	RBS	W3
B.2.1.3	Wetlands	E							
B.2.2	Dewatering Effects on Adjacent Wetlands (ECOL)								
B.2.2.1	Depth to Water Table	A							

C. Socioeconomics

Land use

	Criteria		ANO	GGN	JAF	IP	PNS	RBS	W3
C.4.1	Land Use								
C.4.1.1	Construction and Operation – Related Effects	E&A							

D. Engineering and Cost

1. Health and Safety

	Criteria		ANO	GGN	JAF	IP	PNS	RBS	W3
D.1.2	Pumping Distance (ENG)	A							

2. Transportation and Transmission

	Criteria		ANO	GGN	JAF	IP	PNS	RBS	W3
D.2.1	Railroad Access	E							
D.2.2	Highway Access	E							
D.2.3	Barge Access	E							

3. Land use and Site Preparation

	Criteria		ANO	GGN	JAF	IP	PNS	RBS	W3
D.3.1	Topography (ENG)	E&A							

Existing Nuclear Site Check List

A. Health and Safety

1. Accident Cause Related

			STEPS						
	Criteria		ANO	GGN	JAF	IP	PNS	RBS	W3
A.1.1	Geology/Seismology (GEOL)								
A.1.1.1	Vibratory Ground Motion	S							
A.1.1.2	Capable Fault	S							
A.1.1.3	Surface Faulting and Deformation	S							
A.1.1.4	Geologic Hazards	S							
A.1.1.5	Soil Stability	A&S							
A.1.2	Cooling System Requirements								
A.1.2.1	Cooling Water Supply (HYDRO)	S							
A.1.2.2	Ambient Temperature Requirements (MET)								
A.1.3	Flooding (HYDRO)	S							
A.1.4	Nearby Hazardous Land Uses (LU,SOCEC)								
A.1.4.1	Existing Facilities	S							
A.1.4.2	Projected Facilities	S							
A.1.5	Extreme Weather Conditions (MET)								
A.1.5.1	Winds	S							
A.1.5.2	Rainfall								

2. Accident Effects Related

	Criteria		ANO	GGN	JAF	IP	PNS	RBS	W3
A.2	Accident Effect Related								
A.2.1	Population (DEM)	S							
A.2.2	Emergency Planning (DEM,LU,SOCEC)	S							
A.2.3	Atmospheric Dispersion (MET)	S							

3. Operational Effects Related

	Criteria		ANO	GGN	JAF	IP	PNS	RBS	W3
A.3.1	Surface Water – Radionuclide Pathway								
A.3.1.1	Dilution Capacity	S							
A.3.1.2	Baseline Loadings	S							
A.3.1.3	Proximity to Consumptive Users	S							
A.3.2	Groundwater Radionuclide Pathway (HYDRO&RAD)	S							
A.3.3	Air Radionuclide Pathway (MET, RAD)								
A.3.3.1	Topographic Effects	S							
A.3.3.2	Atmospheric Dispersion	S							
A.3.4	Air-Food Ingestion Pathway (MET,RAD &LU)	S							
A.3.5	Surface Water-Food Radionuclide Pathway (HYDRO<RAD & LU)	S							
A.3.6	Transportation Safety (MET,LU)	S							

B. Environmental

1. Construction Effects on Aquatic Ecology

	Criteria		ANO	GGN	JAF	IP	PNS	RBS	W3
B.1.1	Disruption of Important Species/Habitats (ECOL)	S							
B.1.2	Bottom Sediment Disruption Effects (HYDRO)								
B.1.2.1	Contamination	S							
B.1.2.2	Grain Size	S							

2. Construction Related Effects on Terrestrial Ecology

	Criteria		ANO	GGN	JAF	IP	PNS	RBS	W3
B.2.1	Disruption of Important Species/Habitats and Wetlands (ECOL)								
B.2.1.1	Important Species/Habits	S							
B.2.1.2	Ground Cover/Habitat	S							
B.2.1.3	Wetlands	S							
B.2.2	Dewatering Effects on Adjacent Wetlands (ECOL)								
B.2.2.1	Depth to Water Table	A&S							
B.2.2.2	Proximal Wetlands	S							

3. Operational Effects on Aquatic Ecology

	Criteria		ANO	GGN	JAF	IP	PNS	RBS	W3
B.3.1	Thermal Discharge Effects (ECOL & HYDRO)								
B.3.1.1	Migratory Species Effects	S							
B.3.1.2	Disruption of Important Species/Habitats	S							
B.3.1.3	Water Quality	S							
B.3.2	Entrainment/Impingement Effects (LU & HYDRO)								
B.3.2.1	Entrainment Organisms	S							
B.3.3	Dredging/Disposal Effects (LU & HYDRO)								
B.3.3.1	Upstream Contamination Sources	S							
B.3.3.2	Sedimentation Rates	S							

4. Operational Effects on Terrestrial Ecology
5.

	Criteria		ANO	GGN	JAF	IP	PNS	RBS	W3
B.4.1	Drift Effects on Surrounding Areas (ECOL)								
B.4.1.1	Important Species/Habitat Areas	S							
B.4.1.2	Source Water Suitability	S							

C. Socioeconomics

1. Construction Effects

	Criteria		ANO	GGN	JAF	IP	PNS	RBS	W3
C.1.1	Socioeconomics – Construction – Related Effects (LU & SOCEC)	S							

2. Operation Effects

	Criteria		ANO	GGN	JAF	IP	PNS	RBS	W3
C.2.1	Socioeconomics – Operation	S							

3. Environmental Justice

	Criteria		ANO	GGN	JAF	IP	PNS	RBS	W3
C.3.1	Environmental Justice	S							

4. Land use

	Criteria		ANO	GGN	JAF	IP	PNS	RBS	W3
C.4.1	Land Use	[redacted]							
C.4.1.1	Construction and Operation – Related Effects	S							

D. Engineering and Cost

1. Health and Safety

	Criteria		ANO	GGN	JAF	IP	PNS	RBS	W3
D.1.1	Water Supply (HYDRO)	S							
D.1.2	Pumping Distance (ENG)	S							
D.1.3	Flooding (HYDRO)	S							
D.1.4	Vibratory Ground Motion (GEOL)	[redacted]							
D.1.5	Soil Stability (GEOL)	S							
D.1.6	Brownfield Site Remediation	S							

2. Transportation and Transmission

	Criteria		ANO	GGN	JAF	IP	PNS	RBS	W3
D.2.1	Railroad Access	S							
D.2.2	Highway Access	S							
D.2.3	Barge Access	S							
D.2.4	Transmission	[redacted]							
D.2.4.1	Transmission – Construction	S							
D.2.4.2	Transmission Losses	S							
D.2.4.3	Transmission Services Competition	S							

3. Land use and Site Preparation

	Criteria		ANO	GGN	JAF	IP	PNS	RBS	W3
D.3.1	Topography (ENG)	S							
D.3.2	Land Rights (LU)	S							
D.3.3	Labor Rates (ENG-COST)	S							

Factors for Existing Site Evaluations

Factor		**ANO**	**GGN**	**JAF**	**IP**	**PNS**	**RBS**	**W3**
Seismic Evaluation								
Demographic Changes								
Emergency Planning								
Exclusion Area								
Transmission Access								
Power Pricing								
Water Availability								
Permitting / Licensing Status								
Plans for Existing Units								
Spent Fuel Storage								

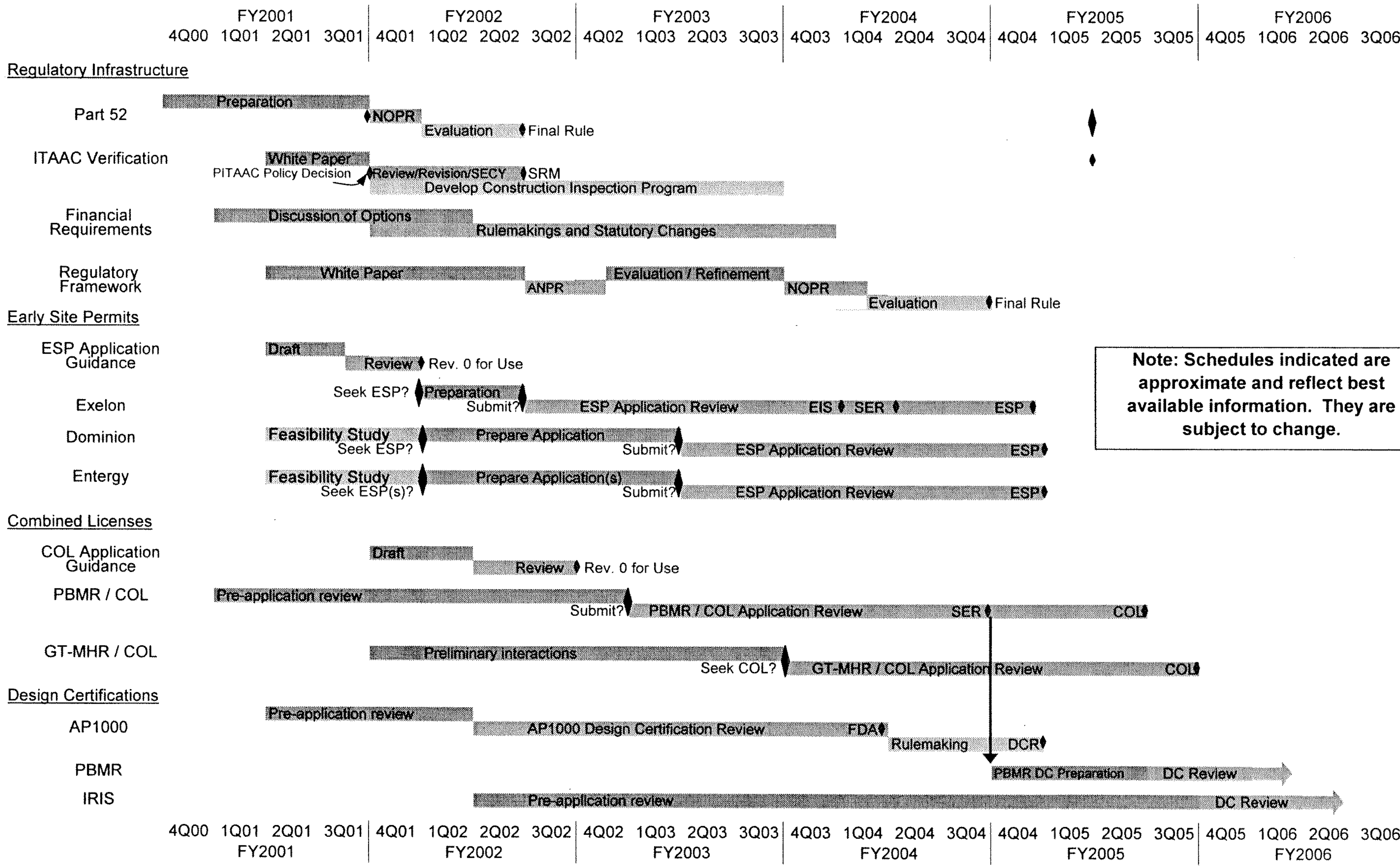
Nuclear Option White Paper

(31 pages, Entergy Business Sensitive, not included)

Integrated Schedule of New Plant Activities

7/29/01

DRAFT -- Integrated Schedule of New Plant Activities -- DRAFT



Note: Schedules indicated are approximate and reflect best available information. They are subject to change.

AP1000 Combined Operating License Plan

(1 page, Westinghouse Proprietary, not included)

AP1000 Schedule

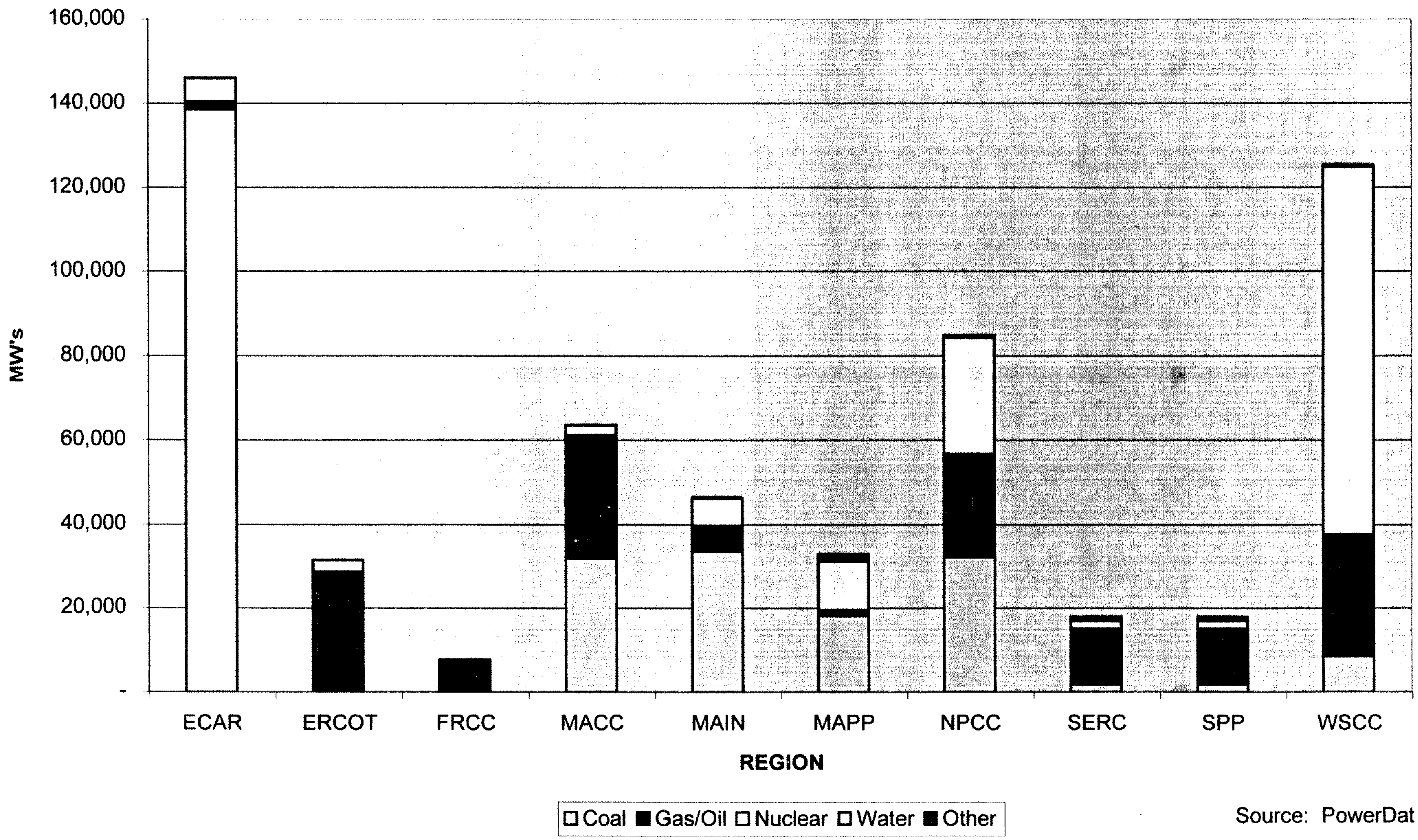
(1 page, Westinghouse Proprietary, not included)

GT-MHR Roadmap

(2 pages not included)

40 Year Sites

CAPACITY (MW)
At Least 40 Years Since Last Unit Addition at Site



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SECTION 3

Report
ESP Site Selection Committee Meeting
September 6, 2001

This report documents results of a meeting of Entergy's ESP Site Selection Committee, held in Power House facility in Jackson, MS on September 6, 2001.

Background

As part of it's overall business planning, Entergy Nuclear is considering preparation of an Early Site Permit, under applicable Nuclear Regulatory Commission (NRC) regulations, to preserve the option of constructing a merchant nuclear power plant, using a standardized (evolutionary or passive) Advanced Light Water Reactor (ALWR) design, in the future. One of the first steps in the ESP process is to select a site (or sites) for which an ESP will be prepared.

As the Region of Interest (ROI) for examining potential sites, Entergy has selected it's fleet of seven existing sites. Justification for this ROI is based on the multiple advantages enjoyed by existing sites in both technical and public acceptance aspects of the licensing process. These advantages include:

- Public support is known
- Site infrastructure is in place
- Local technical expertise exists
- A large body of site characterization data exists
- Political factors are known
- Site access is readily available
- Company liaisons with the local community exist
- NRC has previously approved the site

These factors combine to reduce the scope of studies required to prepare an ESP application and to reduce the risk of the licensing process itself. These advantages are especially important, given the uncertainties associated with filing a new application after a period of inactivity in new nuclear power plant construction. Since new units could be developed at any of the seven sites, the diversity of sites available, combined with advantages of existing sites, clearly justify limiting the ROI to Entergy's existing nuclear units.

Entergy's decision process for site selection involves screening the seven sites, using the existing site criteria listed in Section II in Entergy's Nuclear Site Selection Criteria Guidelines for an Early Site Permit to identify four candidate sites (two in the south and two in the northeast) for more detailed comparison. The four candidates will be characterized in accordance with criteria set forth in *Entergy Nuclear Site Selection Criteria Guidelines for an Early Site Permit*; using these characterizations, the sites will be ranked and one site from each region identified for a potential ESP application. An initial preferred site for an Entergy's ESP application will be identified based on these rankings and on business considerations for a merchant plant.

The purpose of the meeting reported herein was to complete the screening of candidate sites from seven to four, as described above. This report documents the methodology and process used to apply the criteria, the discussions held during the meeting, and the results of the screening and selection process. The meeting agenda and attendees are provided in Attachments 1 and 2, respectively.

Discussion

As described above, ten criteria were initially identified as the basis for screening, as follows:

Seismic Evaluation	Power Pricing
Demographic Changes	Water Availability
Emergency Planning	Permitting/Licensing Status
Exclusion Area	Plans for Existing Units
Transmission Access	Spent Fuel Storage

Overall scope of these criteria is described generically in Reference 1; additional detail on how each criterion was evaluated for this screening process is described in Attachment 3.

Based on initial discussions at the meeting, it was concluded that the importance of public acceptance in the ESP process dictated that the relative status of each site from this perspective should be taken into account in the screening. Accordingly, an eleventh criterion, Public Relations was added to the screening criteria.

Prior to the meeting, subject matter experts/discussion leaders developed information characterizing each site with respect to the each of the screening criteria. This information was presented to the Committee on a criterion-by-criterion basis by the Discussion Group Leads identified on the Agenda. As information on each criterion was presented, Discussion Group Leads proposed an initial rating for each of the sites, scaled from 1 to 5, with 5 being most favorable and 1 being least favorable. Through group discussion and feedback, consensus ratings for each site were developed for each of the criteria.

In addition to site ratings, the Committee also developed weighting factors that characterize the relative importance of each criterion in rating the sites. Weights were assigned on a 1 to 10 scale, with 10 being most important and 1 being least. Participants were polled twice, once before the Discussion Group reports and once after. Individual weight scores were averaged to arrive at final weighting factors.

Results

During initial discussions it was noted that the population density around Indian Point exceeds 500 persons per square mile. NRC guidance indicates that the population density for sites being proposed for nuclear power plants should not exceed this figure, especially if other alternatives exist. For this reason, Indian Point was excluded from further consideration, and ratings for the other criteria were not developed for this site.

Results of the individual site ratings are listed in Table 1. Attachment 3 provides additional detail on the basis for developing these ratings.

Table 1. Existing Site Criterion Ratings

Site Evaluation Factor	**ANO**	**GGN**	**JAF**	**PNS**	**RBS**	**W3**
Seismic Evaluation	4	5	4	3	5	3
Demographic Changes	5	5	5	3	5	4
Emergency Planning	5	5	5	5	5	5
Exclusion Area	4	5	4	3	5	4
Transmission Access	2	5	3	5	3	3
Power Pricing	2	3	1	5	3	3
Water Availability	2	5	5	3	5	4
Permitting/Licensing Status	4	5	3	2	3	3
Plans for Existing Units	4	5	5	4	5	5
Spent Fuel Storage	5	5	5	4	5	5
Public Acceptance	5	5	3	2	5	4

Of the southern sites, Grand Gulf is rated equal to or higher than the other three candidates for all criteria. Of the remaining three southern sites, River Bend is ranked equal to or higher than the other two candidates (Arkansas Nuclear One and Waterford 3) for all but one of the criteria. Thus, Grand Gulf and River Bend were selected as the two potential sites in the south, with Grand Gulf ranking slightly higher.

Criterion rankings for the remaining northern sites varied significantly by criterion with Fitzpatrick rated better (more than two points higher) than Pilgrim for Demographic Changes and Water Availability. Pilgrim was rated similarly better in Transmission Access and significantly better for Power Pricing. Selection of one of these sites over the other requires development of net ratings using weighting factors, as described below.

Weighting factors resulting from the second polling (after completion of the Discussion Group presentations) were developed by averaging results for each of the individual participant's views. Results of the process are listed in the "Weighting Factor" column of Table 2.

Weighting factors were used to develop composite suitability ratings for the northern sites. These ratings were developed by multiplying the site-specific ratings for each criterion by the respective weighting factor and summing over all criteria for each site. Results of this process are provided in Table 2.

Based on these results, Fitzgerald is considered to be the preferred site for preparation of an ESP in the northeast.

Table 2. Composite Suitability Ratings for Northeastern Sites

Site Evaluation Factor	Weighting Factor	ANO Score	ANO Weighted Score	GGN Score	GGN Weighted Score	JAF Score	JAF Weighted Score	PNS Score	PNS Weighted Score	RBS Score	RBS Weighted Score	W3 Score	W3 Weighted Score
Seismic Evaluation	7.2	4	28.8	5	36.0	4	28.8	3	21.6	5	36	3	21.6
Demographic Changes	6.1	5	30.5	5	30.5	5	30.5	3	18.3	5	30.5	4	24.4
Emergency Planning	5.6	5	28.0	5	28.0	5	28.0	5	28.0	5	28	5	28.0
Exclusion Area	6.1	4	24.4	5	30.5	4	24.4	3	18.3	5	30.5	4	24.4
Transmission Access	8.2	2	16.4	5	41.0	3	24.6	5	41.0	3	24.6	3	24.6
Power Pricing	9.1	2	18.2	3	27.3	1	9.1	5	45.5	3	27.3	3	27.3
Water Availability	7.1	2	14.2	5	35.5	5	35.5	3	21.3	5	35.5	4	28.4
Permitting/Licensing Status	6.4	4	25.6	5	32.0	3	19.2	2	12.8	3	19.2	3	19.2
Plans for Existing Units	3.0	4	12.0	5	15.0	5	15.0	4	12.0	5	15	5	15.0
Spent Fuel Storage	2.6	5	13.0	5	13.0	5	13.0	4	10.4	5	13	5	13.0
Public Acceptance	6.6	5	33.0	5	33.0	3	19.8	2	13.2	5	33	4	26.4
Composite Rating			244.1		321.8		261.1		242.4		292.6		252.3

References

1. *Siting Guide: Site Selection and Evaluation Criteria for an Early Site Permit Application*, Final Report, Electric Power Research Institute, August 2001.

2. *Entergy Nuclear Site Selection Criteria Guidelines for an Early Site Permit*, Entergy Nuclear, Inc., August 2001.

Attachment 1

ESP Site Selection Committee Meeting
September 6, 2001
Entergy Power House Substation #2

Agenda

0800 – 0830	Introduction to ESP Goals and Objectives	Kenneth Hughey
0830 – 0900	Introductions to PPE's	Jeff Richardson
0900 – 0945	Site Selection Guidelines	Mike Bourgeois
0945 – 1015	Geographic Information Systems	Bob West
1015 – 1030	Break	
1030 – 1100	Analysis of Federal Regulatory Changes	George Zinke
1100 – 1130	Public Support	Carl Crawford
1130 – 1230	Lunch	
1230 – 1330	First Discussion Group – Lead Transmission Access Power Pricing	Dan Dormady (Tony Walz)
1330 –1345	Break	
1345 – 1445	Second Discussion Group – Lead Seismic Evaluation Exclusion Area Water Availability	Rick Buckley (Bob West)
1445 – 1500	Break	
1500 – 1530	Third Discussion Group – Lead Demographic Changes Emergency Planning	Mike Bourgeois (Curtley Hayes)
1530 – 1600	Forth Discussion Group – Lead Permitting / Licensing Status Plans for Existing Units Spent Fuel Storage	George Zinke
1600 – 1630	Initial Screening Decision Matrix Action	Mike Bourgeois

Attachment 2

Meeting Attendees

Mike Bourgeois	Entergy	Business Development - Projects
Kelle Barfield	Entergy	Generation Communications
Joe Blount	Entergy	Legal
Rick Buckley	Entergy	Environmental
Dan Dormady	Entergy	Business Development - EWO
Mike Dupre	Entergy	Market Intelligence
Curtley Hayes	Entergy	Emergency Planning
Ken Hughey	Entergy	Business Development - Projects
Doug Levanway	Wise Carter	Legal
Jeff Richardson	Entergy	Engineering
Kyle Turner	McCallum-Turner	Consultant
Tony Walz	Entergy	Strategic Analysis
Bob West	FTN	Consultant - Seismic, Geological, Environmental
George Zinke	Entergy	Business Development - Licensing

Attachment 3

The following discussions provide, for each of the criteria, a summary discussion on the bases and rationale on which individual site ratings were assigned. Additional detail on data and analyses supporting these ratings is provided in presentation materials provided by Discussion Group leaders; these materials are provided in Attachment 4.

Seismic Evaluation - Ratings were assigned qualitatively, as follows. Grand Gulf and River Bend were ranked most suitable (5) due to lowest predicted probability of ground acceleration greater than 0.3 g. Fitzgerald and ANO were ranked lower (4), the former because of soil stability problems and the latter because of its proximity to the New Madrid fault. A rating of 3 for Pilgrim and Waterford 3 was assigned based on more complex soil problems.

Demographic Changes - In general, ratings were assigned based on total population figures as derived from the 2000 census, with 5 assigned to the lowest and 3 to the highest nearby population. Waterford was downgraded to a rating of 4 to account for the density of industrial facilities in the site vicinity.

Emergency Planning - Because all sites already have acceptable emergency plans in place, and no new constraints have been identified, all sites were assigned the most suitable rating of 5.

Exclusion Area - All six sites have enough room to site one or more new units. Ratings of 5 were initially assigned a 5 based on the raw amount of new land area available. These ranged from 5 at Grand Gulf, River Bend and Waterford (more than 2,000 acres each) to a 3 for Pilgrim at slightly more than 500 acres. Waterford was downgraded to a 4 to account for development restrictions associated with onsite wetlands and nearby existing industrial facilities.

Transmission Access - Ratings (in parentheses) were assigned based on the potential for achieving required injection capacity and the cost of providing that capacity, as follows.
Pilgrim and Grand Gulf (5) - Highest injection capacity and lowest cost.
River Bend (3) - Limited injection capacity and high cost.
Fitzpatrick (3) - High cost.
Waterford (3) - Limited injection capacity.
ANO (2) - Limited injection capacity and very high cost.

Power Pricing - Ratings were assigned based on professional judgement as to the expected price for power and the ease of delivering power to the anticipated load center at each site. The rationale for site-specific ratings is as follows:
Pilgrim (5) - Highest price and highest probability of connecting to load center
Grand Gulf (3) - Lower price and farther from existing loads. Can connect with loads to the south; could connect to loads from Southern Company and TVA.
Waterford 3 (3) - Near local loads but in gas-heavy area (causing stiff price competition); transmission access constrained and may have to compete with future co-generation.
River Bend (3) - Near local loads but in gas-heavy area (causing stiff price competition).
Arkansas Nuclear One (2) - Difficult access to loads outside the original Entergy service territory; low projected load growth within easy transmission access, which would limit market price.
Fitzpatrick (1) - Low pricing and very difficult access to loads in New York City.

Water Availability - Sites on the Mississippi River were assigned a 5 based on plentiful water supply and minimal thermal impacts; Waterford was downgraded to a 4 to reflect potential for complicating interactions with other nearby intake and discharge structures. Fitzgerald and Pilgrim both have plentiful sources of water, but Pilgrim is viewed to be subject to a very complicated state permitting structure and potential salt drift impacts. Ratings of 5 and 3, respectively, were assigned to these sites. ANO is served by a shallow cooling lake and is already approaching permit limits on discharge temperatures at the existing units during hot weather - a rating of 2 was assigned to account for these difficulties.

Permitting/Licensing Status - Ratings assigned for this criterion were assigned based on a best estimate of the level of intervenor opposition or regulatory difficulty to be encountered in obtaining an ESP at each of the candidate sites. It was noted that some level of national opposition will be focused on any new nuclear plant application. Grand Gulf was felt to be least likely to be subject to significant local opposition. ANO was judged to be subject to similar local opposition but was downgraded to a 4 to account for additional intervention opportunities associated with the Arkansas state permitting process. The Louisiana sites (RBS and W3) were viewed to be subject to considerable opportunistic opposition from within the state and were given a rating of 3. Both Fitzgerald and Pilgrim were felt to be subject to well-funded, active opposition, with more serious potential for intervenors at the latter; these sites were assigned ratings of 3 and 2, respectively.

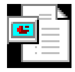
Plans for Existing Units - Pilgrim and ANO were downgraded to a rating of 4 to account for potential complexities associated with pursuing an ESP in parallel with license renewal applications planned for the same time period for these sites.

Spent Fuel Storage - Only Pilgrim was viewed to have constraints for future development of spent fuel storage facilities, because of limited land availability. It was downgraded to a rating of 4, with a 5 rating assigned to the rest of the sites.

Public Acceptance - Ratings were assigned in accordance with findings of an internal Entergy poll of nuclear executives and communications management. Respondents were asked to identify the best site, from among the seven existing plants, for a new nuclear plant based on the perceived level of public acceptance at each. Results of this poll were directly correlated to ratings assigned to the sites.

Attachment 4

Discussion Group Presentation Materials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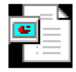
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SECTION 4

ESP Site Selection Committee Meeting

December 5, 2001

ENTERGY NUCLEAR

ESP Site Selection Committee Meeting
12/5/2001
Power House

0800 – 0830	Opening Remarks & Review of the Selection Process to date	Mike Bourgeois
0830 – 0930	Health and Safety Suitability Study	Bob West
0930 – 1000	Break	
1000 – 1100	Environmental Suitability Study	Bob West
1100 – 1130	Weighting Factors	Kyle Turner
1130 – 1230	Lunch	
1230 – 1330	Socioeconomics Suitability Study	Kyle Turner
1330 – 1400	Break	
1400 – 1500	Engineering and Cost Suitability Study	Jeff Richardson
1500 – 1530	Open discussion	
1530 – 1600	Final Ranking & Selection	Mike Bourgeois

Summary Score Card

STEPS

	Criteria	Weight	GGN	GGN	JAF	JAF	PNS	PNS	RBS	RBS
A.1.1	Geology/Seismology (GEOL)	3.77	5	18.8	5	18.8	4	11.3	4	15.1
A.1.1.1	Vibratory Ground Motion	X								
A.1.1.2	Capable Fault	X								
A.1.1.3	Surface Faulting and Deformation	X								
A.1.1.4	Geologic Hazards	X								
A.1.1.5	Soil Stability	X								
A.1.2	Cooling System Requirements	3.27	4	13.1	5	16.3	5	16.3	4	13.1
A.1.2.1	Cooling Water Supply (HYDRO)	X								
A.1.2.2	Ambient Temperature Requirements (MET)	X								
A.1.3	Flooding (HYDRO)	2.40	3	7.2	5	12	5	9.6	4	7.2
A.1.4	Nearby Hazardous Land Uses (LU,SOCEC)	3.35	5	16.7	5	16.7	5	16.7	5	16.7
A.1.4.1	Existing Facilities	X								
A.1.4.2	Projected Facilities	X								
A.1.5	Extreme Weather Conditions (MET)	2.36	5	11.8	4	9.4	3	7.1	3	7.1
A.1.5.1	Winds	X								
A.1.5.2	Rainfall	X								
A.2	Accident Effect Related	4.09	4.33	17.7	4.3	17.7	3	12.2	4	16.4
A.2.1	Population (DEM)	X								
A.2.2	Emergency Planning (DEM,LU,SOCEC)	X								
A.2.3	Atmospheric Dispersion (MET)	X								
A.3.1	Surface Water – Radionuclide Pathway	2.50	5	12.5	4	10	5	12.5	4	10
A.3.1.1	Dilution Capacity	X								
A.3.1.2	Baseline Loadings	X								
A.3.1.3	Proximity to Consumptive Users	X								
A.3.2	Groundwater Radionuclide Pathway (HYDRO&RAD)	2.55	5	12.7	4	10.1	2	5.1	5	12.7
A.3.3	Air Radionuclide Pathway (MET, RAD)	2.50	4	10	5	12.5	4	10	4	10
A.3.3.1	Topographic Effects	X								
A.3.3.2	Atmospheric Dispersion	X								
A.3.4	Air-Food Ingestion Pathway (MET,RAD &LU)	2.50	4	10	5	12.5	5	12.5	4	10
A.3.5	Surface Water-Food Radionuclide Pathway (HYDRO<RAD & LU)	2.41	4	9.6	5	12.1	5	12.1	4	9.6
A.3.6	Transportation Safety (MET,LU)	2.14	5	10.6	5	10.6	4	8.5	5	10.6
B.1.1	Disruption of Important Species/Habitats (ECOL)	2.64	5	13.2	3	7.9	2	5,7	5	13.2
B.1.2	Bottom Sediment Disruption Effects (HYDRO)	2.14	3	6.4	2	4.3	5	10.7	3	6.4
B.1.2.1	Contamination	X								
B.1.2.2	Grain Size	X								
B.2.1	Disruption of Important Species/Habitats and Wetlands (ECOL)	3.18	5	15.9	4	12.7	3	9.5	4	12.7
B.2.1.1	Important Species/Habits	X								

<u>**Summary Score Card**</u>

STEPS

	Criteria	Weight	GGN	GGN	JAF	JAF	PNS	PNS	RBS	RBS
B.2.1.2	Ground Cover/Habitat	X								
B.2.1.3	Wetlands	X								
B.2.2	Dewatering Effects on Adjacent Wetlands (ECOL)	2.77	5	13.8	4	11.1	3	8.32	5	13.8
B.2.2.1	Depth to Water Table	X								
B.2.2.2	Proximal Wetlands	X								
B.3.1	Thermal Discharge Effects (ECOL & HYDRO)	3.64	5	18.2	5	18.2	4	14.5	5	18.2
B.3.1.1	Migratory Species Effects	X								
B.3.1.2	Disruption of Important Species/Habitats	X								
B.3.1.3	Water Quality	X								
B.3.2	Entrainment/Impingement Effects (LU & HYDRO)	3.23	5	16.1	4	12.9	3	9.7	5	16.1
B.3.2.1	Entrainment Organisms	X								
B.3.3	Dredging/Disposal Effects (LU & HYDRO)	2.36	4	9.5	4	9.5	5	11.8	4	9.5
B.3.3.1	Upstream Contamination Sources	X								
B.3.3.2	Sedimentation Rates	X								
B.4.1	Drift Effects on Surrounding Areas (ECOL)	2.36	4	9.5	5	11.8	2	4.7	4	9.5
B.4.1.1	Important Species/Habitat Areas	X								
B.4.1.2	Source Water Suitability	X								
C.1.1	Socioeconomics – Construction – Related Effects (LU & SOCEC)	2.0	3	6	4	8	5	10	4	8
C.2.1	Socioeconomics – Operation	X								
C.3.1	Environmental Justice	1.95	5	9.8	5	9.8	5	9.8	5	9.8
C.4.1	Land Use	X								
C.4.1.1	Construction and Operation – Related Effects	X								
D.1.1	Water Supply (HYDRO)	3.70	3	11.1	4	14.8	3	11.1	4	14.8
D.1.2	Pumping Distance (ENG)	3.05	4	12.2	3	9.1	2	6.1	4	12.2
D.1.3	Flooding (HYDRO)	2.90	4	11.6	3	8.7	3	8.7	3	8.7
D.1.4	Vibratory Ground Motion (GEOL)	4.00	4	16	5	20	3	12	3	12
D.1.5	Soil Stability (GEOL)	3.40	3	10.2	4	13.6	3	10.2	3	10.2
D.1.6	Brownfield Site Remediation	X								
D.2.1	Railroad Access	2.60	3	7.8	3	7.8	2	5.2	3	7.8
D.2.2	Highway Access	2.80	3	8.4	3	8.4	3	8.4	3	8.4
D.2.3	Barge Access	2.85	3	8.5	3	8.5	3	8.5	3	8.5
D.2.4	Transmission	4.80	3.67	17.6	3.67	17.6	4.47	22.4	3	14.4
D.2.4.1	Transmission – Construction	X								
D.2.4.2	Transmission Losses	X								
D.2.4.3	Transmission Services Competition	X								
D.3.1	Topography (ENG)	2.55	4	10.2	4	10.2	3	7.65	4	10.2
D.3.2	Land Rights (LU)	2.75	3	8.25	3	8.25	3	8.25	3	8.25
D.3.3	Labor Rates (ENG-COST)	3.30	5	16.5	4	13.2	4	13.2	5	16.5
	Total			**407**		**405**		**350**		**387**

A.1.1 Geology and Seismology (GEOL)

The objective of this section is to rank the suitability of the four candidate sites with respect to the geologic and seismic setting. To provide a basis for comparative evaluation of these sites, a ranking scheme was developed. A numerical system of weights and ratings based on suitability criteria were assigned to each geologic/seismic category, including vibratory ground motion, capable tectonic sources, surface faulting and deformation, geologic hazards, and soil stability (Sections A.1.1.1 through A.1.1.5) and used to compute (i.e., rate times weight) a GEOL index number for each category. The index numbers for each candidate site were summed to compute a GEOL Index (Tables A.1-1 through A.1-4). The range of GEOL indexes was then used to develop a ranking system for candidate sites (Section A.1.1.6). Sites were ranked on a scale of 1 to 5 with the most suitable sites receiving a ranking of 5.

A.1.1.1Vibratory Ground Motion

Peak ground acceleration (PGA) is a measure of the maximum force experienced by a small mass located at the surface of the ground during an earthquake and it is an index to hazard for some structures. The units of acceleration are measured in terms of "g", the acceleration due to gravity. The particular level of ground motion specified by EPRI (2001, page 3-4) as an exclusionary criteria is PGA 0.30g at a probability of exceedance (PE) of 2% in 50 years (once in 2500 years). Expressed as a percent, 0.30g is 30% g. Maps developed by the U.S. Geological Survey (USGS) as part of the National Earthquake Hazards Reduction Program (Frankel et. al., 1996) were used to compare the relative hazard between sites. Values shown in the table below are from the Internet World Wide Web (http://www.geohazards.cr.usgs.gov/eq/html/zipcode.shtml). None of the areas being considered exceeded EPRI's criteria.

Probabilistic ground motion values in % g.

Plant	PGA(%g) with 2% PE in 50 years
Fitzpatrick (JAF)	8.744328
Pilgrim (PNS)	13.754200
Grand Gulf (GGNS)	7.321575
River Bend (RBNS)	6.398561

Sites with the lowest values of PGA in combination with other criteria (e.g. no known deleterious soil conditions) would receive the highest ranking. Seismic hazard assessments in the CEUS rely heavily on historical seismicity to quantify the hazard, therefore, vibratory ground motion was assigned a high weight factor. Following are the assigned weights and ratings for vibratory ground motion.

Weight	Range	Rating	GEOL Index Range
5	PGA(%g) 0–3 3–6 6–9 9–12 12–15 15–18 18–21 21–24 24–27 27–30	 1 2 3 4 5 6 7 8 9 10	0–50

Based on the information shown in Tables A.1-1 through A.2-4, candidate sites received the following ratings and computed GEOL index numbers for vibratory ground motion:

Candidate Site	Rating	GEOL Index No.
JAF	3	15
PNS	5	25
GGNS	3	15
RBNS	3	15

A.1.1.2 Capable Tectonic Structure or Source

No absolute exclusionary criteria have been identified. Capable tectonic structures are addressed as an avoidance criteria, therefore, the objective of this section is to identify the existence of capable or potentially capable tectonic structures within 200 miles of a site. Candidate sites that are furthest from capable or potentially capable tectonic structures are considered more suitable.

EPRI's approach to initial characterization is to follow NRC's previous guidance for determining which faults would be significant in determining the Safe Shutdown Earthquake (SSE) by identifying minimum fault lengths for various distances out to 200 miles from a site. EPRI regards this as an initial valid approach to initial characterization, although it is not specifically addressed in current regulations for ESP. This approach presented a problem for this screening level evaluation because 1) there is an ambiguous relationship between geological features and earthquakes in the CEUS, and few earthquakes have been convincingly associated with mapped faults (NRC 1997, Appendix D); 2) many of the faults in the CEUS are associated with tectonic structures that resulted from ancient tectonic forces that are no longer present; and 3) growth faults, which are over 70 miles long and occur less than 25 and 100 miles from two candidate sites, would be considered significant using this approach even though they are probably not capable. For these reasons, the database compiled by the USGS was used to identify capable and potentially capable tectonic sources within a 200 mile radius of candidate sites.

It was assumed that capable and potential capable tectonic sources , which are Quaternary features that may generate strong ground motion (NRC 1997, Appendix A) fall into two categories as defined by Crone and Wheeler (2000, page 5):

- Class A features have good geologic evidence of tectonic origin and are potentially seismogenic; and
- Class B features have geologic evidence that supports the existence of a seismogenic fault or suggests Quaternary deformation, but the currently available geologic evidence for Quaternary tectonic activity is less compelling than for a Class A feature.

The table below shows a list of Class A and Class B features within a 200 mile radius of each candidate site.

Feature	Class	Site	Distance from site (mi)
Newbury liquefaction features	A	PNS	greater than 50 to 100
Gulf margin normal faults	B	GGNS	greater than 50 to 100
Wiggins Uplift	B	GGNS	greater than 100 to 150
Monroe Uplift	B	GGNS	greater than 50 to 100
Gulf margin normal faults	B	RBNS	greater than 0 to 25
Wiggins Uplift	B	RBNS	greater than 50 to 100
Monroe Uplift	B	RBNS	greater than 100 to 200

The existence of capable tectonic sources can impact the determination of the SSE, especially those near a site. Following are the assigned weights and ratings for capable tectonic sources:

Weight	Range	Rating	GEOL Index Range
Class A 2	none within 200-mi radius greater than 100 to 200 mi greater than 50 to 100 mi greater than 25 to 50 mi 0 to 25 mi	0 2 3 4 5	0–10
Class B 1	none within 200-mi radius greater than 100 to 200 mi greater than 50 to 100 mi greater than 25 to 50 mi 0 to 25 mi	0 2 3 4 5	0–5

Based on the information shown in Tables A.1-1 through A.2-4, candidate sites received the following ratings and computed GEOL index numbers for capable tectonic sources:

Class A

Candidate Site	Rating	GEOL Index No.
JAF	0	0
PNS	3	6
GGNS	0	0
RBNS	0	0

Class B

Candidate Site	Rating	GEOL Index No.
JAF	0	0
PNS	0	0
GGNS	3	3
RBNS	4	4

Additional information is provided below with respect to Class A and Class B features in the area of candidate sites. Where appropriate, Class C features are mentioned. Crone and Wheeler (2000, p.7) assigned some features to Class C because there is lack of geologic evidence for Quaternary seismic faulting so these features do not meet NRC's definition of capable tectonic source. Class C features are discussed in this section because they have been associated with seismic activity, and the uncertainty in the locations of moderate– to large–magnitude historical earthquakes and the association of these events with alternative seismic source zones may be issues at some sites. Non-capable faults that have been identified near candidate sites are addressed in Section A.1.1.3.

<u>James A. Fitzpatrick (JAF)</u>

- There are two Class C features located greater than 100 to 200 miles from the JAF site— the Champlain lowland normal faults (Crone and Wheeler 2000, page 186), and the Cornwall-Massena earthquake (crone and Wheeler 2000, page196). The most damaging earthquake occurred in 1944 near Massena Center, NY (intensity VIII, magnitude 6.0). Massena Center is located 180 mi from JAF, which is located in a region that is considered seismically inactive (Entergy Nuclear Northeast 2001, p. 2.6-1).
- The nearest significant fault is the Clarendon-Linden Fault zone, which is a Class C feature (Crone & Wheeler 2000, p.190) located 90 miles west of the candidate site. Medium sized earthquakes have been associated with the fault zone. This

fault zone trends through Wyoming County where the largest recorded earthquake in western New York occurred 110 mi from JAF near Attica, NY in 1929 (intensity VII, magnitude 5.2) (www.nysm.nysed.gov/geosige.html).

- A minor local fault occurs approximately 40 miles southeast near Syracuse (Entergy Nuclear Northeast 2001, p. 2.5-1). This fault is not associated with any Class A, B, or C features as defined by Crone & Wheeler (2000).

Pilgrim Nuclear site

- The Newbury liquefaction features (Class A), which are evidence for Quaternary faulting in northeastern Massachusetts, are located approximately 60 miles northwest of the Pilgrim nuclear site. The liquefaction is recognized as the type that is caused by strong ground motion, and it occurred during an earthquake of intensityVII in 1727. No mapped faults are associated with (Crone & Wheeler 2000, p.95).
- One of the most significant earthquake (maximum intensity VIII, estimated magnitude 6) in the Northeast occurred in 1755 off Cape Ann about 60 mi to the north of the Pilgrim nuclear site. The causative fault remains unidentified.
- Thrust faults occur 25 mi north and west of the site. A major fault system comprising the east-west Connecticut structural alignment is located about 30 mi south of the site (2.5-9). The nearest mapped fault is located about 17 miles to the west of the site (Entergy Nuclear Generating Company 1999, p. 2.5-9). None of these faults are associated with the Class A, B, or C features described by Crone & Wheeler (2000).

Grand Gulf and River Bend Nuclear Sites

- These candidate sites are located in a region of minimal historical seismicity within the Gulf Coast Basin tectonic province. No capable faults are known to occur in the Gulf Coast Basin (Bechtel 1994, p. 2.5-44). The nearest area of known faulting associated with high historical seismic activity is the Reelfoot scarp and New Madrid seismic zone (Class A), located 220 mi north of Grand Gulf nuclear site (Bechtel 1994. P. 2.5-24) and 300 mi north of River Bend nuclear site (Crone & Wheeler, 2000 p. 4; Gulf States Utilities Company et al.1985, p.2.5-103). This is the area most likely to produce earthquakes that could affect Louisiana (Stevenson & McCulloh 2001, p.7) and is a potential source of ground motion at the Grand Gulf Site (Bechtel 1994, p. 2.5-42).

- There are three Class B features identified within a 200 mile radius of these candidate sites— the Wiggins Uplift, the Monroe Uplift, and the Gulf margin normal faults.

The Wiggins uplift expands and area from extreme southeastern Louisiana across southern Mississippi to Alabama. Data suggest that Quaternary deformation is occurring on the uplift but it is not clear if the deformation is tectonic or related to other non-tectonic processes such as salt tectonics or differential subsidence. There is no evidence of movement on specific faults (Crone & Wheeler 2000, p. 169).

The Monroe Uplift is a small structural dome centered in extreme northeastern Louisiana and west central Mississippi, and it is approximately 80 miles in diameter. Geomorphic evidence infers vertical uplift of the feature at an uplift rate of less than 0.2 mm/yr; however, there is no evidence of movement on specific faults. It is not clear if the uplift reflects tectonic processes that produce tectonic strain that could be released by damaging earthquakes (Crone & Wheeler 2000, p. 137-142 and p.156-158).

The Gulf-margin normal faults are a belt of mostly seaward facing normal faults that border the northern Gulf of Mexico in westernmost Florida, southwestern Alabama, southern Mississippi, all of Louisiana and southernmost Arkansas, and eastern and southern Texas (Crone & Wheeler 2000, pages 148-151). Many faults of widely varying lengths are mapped in this belt. The belt consists of largely of gravity related or growth faults and antithetic faults related to growth faults, which generally result in non-tectonic deformation (NRC 1997, Appendix D.2.5). Epicenter maps show only sparse, low-magnitude seismicity within the Gulf-margin fault belt, and faults in this belt are not regarded as having the capacity to generate damaging vibratory ground motion (NRC 1997, Appendix D.2.5). Crone & Wheeler (2000, p. 7) assigned the Gulf-margin normal faults to Class B even though they are not considered true seismic sources and are, therefore, not capable. Growth faults can pose a surface displacement hazard even though offset most likely occurs at a much less rapid rate than that of tectonic forces .

An example of one of the longer and more important of these growth faults is the Pickens-Gilbertown fault zone located about 60 miles east-northeast of the Grand Gulf site (Bechtel 1994, p. 2.5-17). Other Gulf-margin fault zones within 200 miles of the site include the south Arkansas fault zone and the Baton Rouge fault zone, both over 100 miles from the Grand Gulf site (Bechtel 1994, p. 2.5-16; MP&L et al. 1978, p.2.5-4). The Gulf-margin fault belt in Louisiana is represented by the Tepetate and Baton Rouge fault systems, which trend east-west through southern Louisiana and are located about 12 miles south of the River Bend nuclear site (Gulf States Utilities Company et al. 1999, p. 2.5-30). These faults are known to be active because of the cumulative damage done to structures located on and near certain fault segments (McCulloh 2001, p.1).

A.1.1.3 Surface Faulting and Deformation

No absolute exclusionary criteria have been identified with regard to surface faulting and deformation. Suitability criteria have been established based on the occurrence of surface faulting and tectonic and non-tectonic structures within a 25-mi and 5-mi radius of candidate sites, as follows (EPRI 2000, p.3-7):

Within 25 miles

- Any such structures altogether (Best)
- Potential non-capable structures
- Potential capable structures (Least)

Within 5 miles

- Any such structures altogether (Best)
- Potential non-capable structures
- Potential capable structures
- Fault exceeding 1,000 feet in length
- Capable fault exceeding 1000 feet in length (Least)

The potential for surface faulting or deformation primarily concerns plant design, therefore, features identified within 5 miles of a candidate site received a higher weight. Following are the assigned weights and ratings for surface faulting and deformation:

Weight	Range	Rating	GEOL Index Range
within 25 mi–1	No structures Potential non-capable structures Potential capable structures	0 1 5	0–5
within 5 mi–2	No structures Potential non-capable structures Potential capable structures Fault exceeding 1,000 feet in length Capable fault exceeding 1,000 feet in length	0 2 3 4 5	0–10

Based on the information shown in Tables A.1-1 through A.2-4, candidate sites received the following ratings and computed GEOL index numbers for surface faulting and deformation:

Within 25 miles

Candidate Site	Rating	GEOL Index No.
JAF	0	0
PNS	1	1
GGNS	1	1
RBNS	1	1

Within 5 miles

Candidate Site	Rating	GEOL Index No.
JAF	2	4
PNS	0	0
GGNS	0	0
RBNS	0	0

A.1.1.4 Geologic Hazards

Based on EPRI guidance (2000, p. 3-7) sites having the following geologic and man-made conditions should be avoided:

- Areas of active (and dormant) volcanic activity,
- Subsidence areas caused by withdrawal of subsurface fluids such as oil or groundwater, including areas which may be effected by future withdrawals,
- Potential unstable slope areas, including areas demonstrating paleolandslide characteristics,
- Areas of potential collapse (e.g. karst areas, salt, or other soluble formations),
- Mined areas, such as near-surface coal mined-out areas, as well as areas where resources are present and may be exploited in the future,
- Areas subject to seismic and other induced water waves and floods.

Sites furthest away from these features would be considered the most suitable sites. Following are the assigned weight and rating used for geologic hazards:

Weight	Range	Rating	GEOL Index Range
1	Geologic hazard(s) present	1	0–1

As shown on Tables A.1-1 through A.1-4, the candidate sites are considered equally suitable because no features that would present potentially hazardous conditions were identified at these locations.

A.1.1.5 Soil Stability

No absolute exclusionary criteria have been identified with respect to soil stability. Soil stability is addressed as an avoidance criterion. Certain soil properties have unfavorable characteristics in association with vibratory ground motion. These soil properties include poor mineralogy, low density soil (lack of compaction), and high water content (or high water table). Sites with the highest values of PGA in combination with deleterious site soils would receive a relatively lower rating. Sites having rock foundations or more suitable soil conditions are considered to be better sites. Following are the assigned weights and ratings for soil stability:

Weight	Range	Rating	GEOL Index Range
2	Rock site Deep soil site, no known deleterious soil conditions Deep soil site with potential stability issues, or insufficient information available to assign a rating of 1	0 1 2	0–2

Based on the information shown in Tables A.1-1 through A.2-4, candidate sites received the following ratings and computed GEOL index numbers for soil stability:

Candidate Site	Rating	GEOL Index No.
JAF	0	0
PNS	2	4
GGNS	1	2
RBNS	2	4

A.1.1.6 Ranking for Candidate Sites

The GEOL index numbers for this ranking scheme range from 5 to 85. This range of indexes was used to develop a ranking system to compare the suitability of candidate sites as follows:

GEOL Index Range	Rank
5–21	5
22–37	4
38–53	3
54–69	2
70–85	1

GEOL index numbers for each candidate site were summed. The resulting GEOL index was compared to the GEOL index ranges in the above table to determine the rank for each site. Based on the GEOL evaluation, candidate sites were ranked as follows:

Candidate Site	GEOL Rating	Rank
JAF	20	5
PNS	36	4
GGNS	21	5
RBNS	25	4

A.1.1.7 References Cited

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Table A.1-1 GEOL Rating for James A. Fitzpatrick (JAF)

Feature	Source	Weight	Rating	Number
Vibratory Ground Motion	PGA 8.74%g with 2% PE in 50 years	5	3	15
Capable Tectonic Source (Class A)	No Class A features were identified within a 200-mile radius of the candidate site (Crone & Wheeler 2000, page 4).	2	0	0
Capable Tectonic Source (Class B)	No Class B features were identified within a 200-mile radius of the candidate site (Crone & Wheeler 2000, page 8).	1	0	0
Surface Faulting & Deformation within 25 mi	No surface faulting or deformation was identified other than that described by Entergy Nuclear Northeast (2001) for a 5-mi radius (below).	1	0	0
Surface Faulting & Deformation within 5 mi	Holocene displacements were encountered in the foundation of the current reactor. Entergy Nuclear Northeast (2001, p. 2.5-1) attributed the fault displacement to non-tectonic glacial rebound forces (post-glacial unloading structures) and argued that these faults are not capable tectonic sources as defined by the NRC (1977).	2	2	4
Geologic Hazard	Consistent with regional and site geology described in Section 2.5 of the Final Safety Analysis Report (Entergy Nuclear Northeast 2000) there are no natural features such as tectonic depressions, cavernous conditions, or karstic terrain in the site area which would present potentially hazardous conditions.	1	0	0
Soil Stability	JAF is a rock site; however, surface soils consist of mixtures of silts, sands, gravels, cobbles and some clay materials comprise a relatively thin layer of till at the site. The total thickness of the till layers varies from 0 to as much as 10 or 12 ft. The till layers lie directly on the top of the Oswego sandstone. All structures of the existing plant are founded directly upon sandstone bedrock. The sandstones are hard, competent material, well suited to the foundations of the plant (Entergy Nuclear Northeast 2001, p.2.5-1).	2	0	0
			GEOL Index	**20**

Table A.1-2 GEOL Rating for the Pilgrim Nuclear Site (PNS)

Feature		Weight	Rating	Number
Vibratory Ground Motion	PGA 13.75%g with 2% PE in 50 years	5	5	25
Capable Tectonic Source (Class A)	The Newbury liquefaction features (Class A), which are evidence for Quaternary faulting in northeastern Massachusetts, are located approximately 60 miles northwest of the Pilgrim nuclear site. The liquefaction is recognized as the type that is caused by strong ground motion, and it occurred during an earthquake of intensityVII in 1727. No mapped faults are associated with (Crone & Wheeler 2000, p.95).	2	3	6
Capable Tectonic Source (Class B)	No Class B features were identified within a 200-mile radius of the candidate site (Crone & Wheeler 2000, p. 8).	1	0	0
Surface Faulting & Deformation within 25 mi	Potential non-capable structures occur within 25 miles of the Pilgrim nuclear site. These structures include thrust faults occur 25 mi north and west of the site and the nearest mapped fault, which is located about 17 miles to the west of the site (Entergy Nuclear Generating Company 1999, p. 2.5-9). None of these faults are capable tectonic structures as defined by NRC (1977).	1	1	1
Surface Faulting & Deformation within 5 mi	Based on site investigations that included onshore and offshore drilling, geologic or bathymetric mapping, and seismic surveys there are apparently no known faults within a 5-mile radius of the site (Entergy Nuclear Generating Company 1999, p. 2.5-9).	2	0	0
Geologic Hazard	Consistent with regional and site geology described in Section 2.5 of the Final Safety Analysis Report (Entergy Nuclear Generating Company 1999) there are no natural features such as tectonic depressions, cavernous conditions, or karstic terrain in the site area which would present potentially hazardous conditions.	1	0	0
Soil Stability	PNS is a deep soil site, no information was found regarding soil stability. The water table is relatively shallow (see A.3.2), therefore, there may be potential for liquefaction.	2	2	4
			GEOL Index	**36**

Table A.1.3 GEOL Rating for the Grand Gulf Nuclear Site (GGNS)

Feature		Weight	Rating	Number
Vibratory Ground Motion	PGA 7.32%g with 2% PE in 50 years	5	3	15
Capable Tectonic Source (Class A)	No Class A features were identified within a 200-mile radius of the candidate site (Crone & Wheeler 2000, page 4).	2	0	0
Capable Tectonic Source (Class B)	There are three Class B features identified within a 200-mi radius of GGNS. The closest feature is the Monroe Uplift which is located greater than 50 to 100 mi from the site (Crone & Wheeler 2000, p.156-58).	1	3	3
Surface Faulting & Deformation within 25 mi	No potential capable or non-capable structures within 25 miles of the site (MP&L et al. 1978, p. 2.5-4; Bechtel 1994, Fig 2.5-22).	1	1	1
Surface Faulting & Deformation within 5 mi	No faults occur within 5 miles of the site. Possible fault zones were investigated but no evidence was found supporting the existence of faults in the area (Bechtel 1994, p. 2.5-51, -52).	2	0	0
Geologic Hazard	No areas of subsidence areas caused by withdrawal of subsurface fluids such as oil or groundwater, including areas which may be effected by future withdrawals were identified by Bechtel (1994, p. 2.5-28). No natural features (e.g. tectonic depressions, salt, or cavernous or karstic terrain) which could cause subsidence at this site were identified by Bechtel (1994, p. 2.5-28). No activity associated with removal of mineral deposits has or will effect foundation material at the site (Bechtel 1994, p. 2.5-27, -28)	1	0	0
Soil Stability	GGNS is a deep soil site. Assuming the Catahoula Formation is the foundation-bearing stratum for the major plant structures, there are no materials at the site that are hazardous or may become hazardous due to lack of consolidation, induration, variability, high water content, solubility, or undesirable response to natural or induced site conditions (Bechtel 1994, p. 2.5-53).	2	1	1
			GEOL Index	**20**

Table A.1-4 GEOL Rating for River Bend Nuclear Site (RBNS)

Feature		Weight	Rating	Number
Vibratory Ground Motion	PGA 6.40%g with 2% PE in 50 years	5	3	15
Capable Tectonic Source (Class A)	No Class A features were identified within a 200-mile radius of the candidate site (Crone & Wheeler 2000, page 4).	2	0	0
Capable Tectonic Source (Class B)	There are three Class B features identified within a 200-mi radius of RBNS. The closest features are the Gulf margin normal faults are located less than 25 miles mi from the site (Crone & Wheeler 2000, p. 169).	1	5	5
Surface Faulting & Deformation within 25 mi	Based on Crone & Wheeler's (2000) classification, growth faults which occur within 25 miles of the River Bend site would be considered potentially capable structures. These faults, however, generally show movement as a gradual form of fault creep rather than in conjunction with detectable earthquakes (Gulf States Utilities 1999, p. 2.5-101), and are therefore considered non-capable for this rating.	1	1	1
Surface Faulting & Deformation within 5 mi	No capable faults are known to exist within 5 miles of the River Bend nuclear site (Gulf States Utilities Companies 1999, p. 2.5-103). No surface faulting was identified within 5 miles of the site (Gulf States Utilities Companies, et al. 1999, p. 2.5-4). The nearest surface fault to the site is the east-west trending Zachary Fault (growth). Its surface fault trace ends 8.0 miles southeast of the site. A westward projection of this fault would pass 5.5 mi south of the site. (Gulf States Utilities Companies 1999, p. 2.5-101).	2	0	0
Geologic Hazard	Gulf States Utilities Company et al. 1999, p. 25-106) identified regional subsidence due to groundwater pumping that is centered in Baton Rouge but found no evidence of subsidence at the site and concluded that subsidence due to groundwater withdrawals in Baton Rouge would be extremely small and uniform across the site area, and would not affect the stability, operation, or safety of the plant (Gulf States Utilities Company et al. 1999, p. 2.5-106). There are no natural features (e.g. tectonic depressions, salt, or cavernous or karstic terrain) which would present potentially hazardous conditions (Gulf States Utilities Company et al. 1999, p. 2.5–6, -69, and -103).	1	0	0
Geologic Hazard (cont')	There is no mineral extraction occurring within a	1	0	0

	wide area surrounding the site; the nearest oil and/or gas production is located about 7 mi southeast of the plant from the Upper Cretaceous Tuscaloosa Formation at a depth of about 3 mi. (Gulf States Utilities Company et al. 1999, p. 2.5-3).			
Soil Stability	River Bend is a deep soil site. Site soils present no problem because of their mineralogy (Gulf States Utilities Company et al. 1999, p. 2.5-72). Soils above approximately 20 ft msl at the existing site contain some fine sand and clayey sand layers and were removed prior to plant construction because there were concerns that these soils could not withstand the motion associated with the assumed SSE without liquefaction. (Gulf States Utilities Company et al. 1999, p.2.5-72). The soil on which current structures are founded, however, are strong, statically and dynamically stable materials. They are not susceptible to loss of strength, subsidence, or liquefaction (minimum factor of safety 2.6) as a result of the motion associated with the assumed SSE (Gulf States Utilities Company et al. 1999, p. 2.5-3 and 2.5-4).	2	2	4
			GEOL Index	**25**

A.1.2 Cooling System Requirements

Cooling system requirements are important siting considerations for new power generating facilities. The purpose of this section is to rank the candidate sites with respect to specific cooling system requirements. The principle requirements of interest are the quantity of cooling water available and the ambient air temperature (Reference 1, Section 3.1.1.2.1). Exclusionary and avoidance conditions apply to the evaluation of candidate sites with respect to these cooling system requirements.

Cooling water supply

Cooling water supply requirements for units with closed-cycle or once-through cooling systems are summarized below.

Cooling System Type	Requirement	Composite Certified ALWR Value
Closed-cycle	Make up flow rate (gpm)	20,600 (34,500)
Closed-cycle	Maximum Water Consumption (gpm)	17,700
Closed-cycle	Monthly Average Water Consumption (gpm)	15,400
Once-through	Flow rate (gpm)	1,100,000

The four candidate sites are located on water bodies that can easily meet the required closed-cycle cooling water flows above. No significant concerns were identified regarding the capacity of these water bodies to even provide the required once-through cooling water flow. The GGNS and RBS sites, however, were considered to be less suitable than the JAF and PNS sites. The 7-day,10-year low flow of the Mississippi River near the GGNS and RBS sites is approximately100,000 cfs (Reference 2). Under extreme low flow conditions, once-through cooling water flow diverted to GGNS and RBS would be no more than about 1% of the total low of the Mississippi River.

Ambient Temperature Requirements

Available data was obtained for major weather reporting stations nearest each site. Meteorological data obtained from the National Oceanic and Atmospheric Administration's National Climate Data Center (Reference 3) indicated the four candidate sites meet the ambient temperature exclusionary and avoidance criteria addressed in Reference 1(Section 3.1.1.2.2). Actual meteorological conditions at the four candidate sites, however, may vary from the data collected and evaluated for these reporting weather stations.

The four sites were then compared to one another to assess their relative suitability with respect to selected temperature extremes and frequency values. A summary of dry bulb (db) and wet bulb (wb) temperature values at various extremes and frequencies for the four sites in shown in the table below.

Ambient Temperatures	GGNS	JAF	PNS	RBS
Highest temp of record (F db)	107	98	102	105
Lowest temp of record (F db)	2	-26	-12	8
1.0% occurrence temp (F db)	94	86	88	92
1.0 % occurrence temp (F wb)	79	74	74	80
0.4% occurrence temp (F db)	96	89	91	94
0.4 % occurrence temp (F wb)	80	75	76	80

Ambient air temperature characteristics of a potential site affect the design of heat removal systems. The four sites were compared to determine which site has the most suitable ambient air characteristics with respect to the PPE values outlined in Reference 2, Section 3.1.1.2.2. With the

exception of extreme low temperature values, sites with the lowest dry bulb and wet bulb temperatures were the most suitable. A summary of ranking scores for selected ambient temperatures at each of the sites is shown below. The average values were then used to assign overall relative ranking scores.

Ambient Temperatures	**GGNS**	**JAF**	**PNS**	**RBS**
Highest temp of record (F db)	3	5	4	4
Lowest temp of record (F db)	5	3	4	5
1.0% occurrence temp (F db)	4	4	4	5
1.0 % occurrence temp (F wb)	3	5	5	3
0.4% occurrence temp (F db)	4	5	5	4
0.4 % occurrence temp (F wb)	3	5	4	3
Average value	3.7	4.5	4.3	4.0

Relative Ranking Scores:

The sites assigned relative ranking scores for the suitability of the cooling water supply and the ambient air temperature characteristics. Sites with the largest supply of cooling water and the optimal ambient air temperature values were assigned a ranking score of 5.

Criteria	**GGNS**	**JAF**	**PNS**	**RBS**
Cooling water supply	4	5	5	4
Ambient air temperature	4	5	5	4
Ranking Score	**4**	**5**	**5**	**4**

References:

1. EPRI, 2001. Siting Guide: Site Selection and Evaluation Criteria for an Early Site Permit Application. EPRI Report.
2. USGS, 1980. Low-flow characteristics of Louisiana Streams. In cooperation with the Louisiana Department of Transportation and Development, Technical Report No. 22.
3. NOAA, 2001. Engineering Weather Data, Version 1.0. Available from the National Climatic Data Center, Ashville, NC.

A.1.3 Flooding

The purpose of this section is to evaluate the suitability of the four candidate sites with respect to potential flooding. Existing units licensed at the sites meet the exclusionary and avoidance siting criteria outlined in Reference 1 (Section 3.1.1.3). These criteria exclude potential sites within major wetlands, areas less than one foot above the maximum flood elevation.

A summary of pertinent flood related information for the four sites is shown in the table below. Unless otherwise referenced, information in this table is addressed in Section 2.4 of the candidate site FSAR.

Hydrologic terms used in the table include:

- Project Design Flood (PDF) - Generally used interchangeably with the term Standard Project Flood. It is a flood that can be expected from the most severe meteorologic and hydrologic conditions which are reasonably <u>characteristic</u> for an area. Frequency of occurrence can range for a few hundred years to a few thousand years. Flow is approximately 50% of the Probable Maximum Flood.

- Probable Maximum Flood (PMF) - A flood that can be expected from the most severe meteorologic and hydrologic conditions which are reasonably <u>possible</u> for an area. PMF values are typically used in the design of major dams and nuclear power plants.

- Probable Maximum Precipitation (PMP) – Intense precipitation values published by US Weather Bureau for specific locations. PMP values are used to calculate PMF stages and flows. The GGNS MPF values, for example, were calculated using a PMP value of 8.2 inches of rain in 30 minutes.

Criteria	GGNS	JAF	PNS	RBS
Site grade elevation	132.5 ft. msl (Safety related equipment flood protected to elevation 133' 7.5")	272 ft msl(?)	23 ft msl	95 ft msl. (Safety related equipment is either above 98 ft or flood protected.)
Maximum flood elevation (from main water body)	Mississippi River 100-yr flood elevation is 91.9 feet. NGVD[2]. Project Design Flood elevation is 96.2 ft. Probable Maximum Flood (PMF) elevation is ~103 ft.	260 ft Elevation includes wave runup, wind setup, and max rainfall contributions. COE 500-yr flood elevation is249.7 ft msl[3].	100-yr storm surge is 11 ft msl. Design maximum storm surge elevation is 13.5 ft msl. @4000-yr return frequency.	Mississippi River Project Design Flood (PDF) elevation is 54.3 ft NGVD[4]. PMF elevation estimated to be 60ft.
Maximum flood elevation (from onsite drainage, local streams, etc.)	PMF elevations for on-site drainage Steams A/B are 128.93 ft and <132.8 ft, respectively.	No maximum PMF elevations or concerns noted in FSAR.	No maximum PMF flood elevations or concerns noted in FSAR.	Maximum PMF elevations near RBS for Grant's Bayou and West Creek may exceed grade elevation.
Freeboard	29 ft above Mississippi River PMF. ~1ft above local streams PMF	12 ft above Lake Ontario maximum flood elevation.	9.5 ft above design maximum storm surge elevation for Atlantic Ocean	Approximately 35 ft above Mississippi River PMF elevation. ~ 1 ft above local streams PMF
Downstream ice jam flooding concerns	FSAR analysis addressed debris obstructing on-site stream culverts. Results addressed in max flood elevation.	None noted in FSAR	None noted in FSAR	FSAR analysis included debris/sediment obstructions at culverts/bridges. Results addressed in max flood elevation.
Storm-related flooding concerns	PMP stormwater ponding concern addressed in Maximum flood elevation above.	No PMP stormwater ponding issues addressed in FSAR. Due to site layout, no concerns are likely.	No PMP stormwater ponding issues addressed in FSAR. Due to site layout, no concerns are likely.	PMP stormwater ponding to elevation 95 ft. Flooding concerns with site drainage system, Grants Bayou and West Creek.
Seismically induced flooding concerns	No concerns with seismic induced Tsunami flooding.	None noted in FSAR. Coastal sites, however, have more concerns than inland sites.	None noted in FSAR. Coastal sites, however, have more concerns than inland sites.	No concerns with seismic induced Tsunami flooding.
Upstream dam failure concerns	None noted in FSAR	None noted in FSAR	None noted in FSAR	None noted in FSAR

Ranking Scores:

The relative suitability of the four candidate sites with respect to flooding is summarized below. Based on available information, the JAF site was determined to be the most suitable site and was assigned a ranking score of 5. Although the GGNS and RBS sites were well above Mississippi River maximum flood hazards, Probable Maximum Flood hazards from local streams will significantly increase construction cost. These sites were considered to be less suitable with respect to flooding than JAF and PNS.

GGNS	JAF	PNS	RBS
3	5	4	3

References:

1. EPRI, 2001. Siting Guide: Site Selection and Evaluation Criteria for an Early Site Permit Application. EPRI Report.
2. US Army Corps of Engineers, 2001. Letter dated October 17, 2001, from Douglas J. Kamien, PE, Vicksburg District, to Conrad Battreal, FTN Associates, Ltd.
3. US Army Corps of Engineers, 2001. Facsimile transmittal dated September 18, 2001, from Caroline Lobaugh, Buffalo District, to Conrad Battreal, FTN Associates, Ltd. Transmittal included four pages from a report entitled: Revised Report on Great Lakes Open-coast Flood Levels. US Army COE, Detroit Michigan, April 1988.
4. US Army Corps of Engineers, 2001. Letter dated November 5, 2001, from Rodney Greenup, Flood Plain Manager, New Orleans District, to Conrad Battreal, FTN Associates, Ltd.

A.1.4 - Hazardous Facilities

The purpose of this criterion is to include NRC guidance on considerations regarding the nature and proximity of man-related hazards (dams, airports, transportation routes, and military and chemical manufacturing and storage facilities). Existing units licensed at the four candidate sites have evaluated potential hazards from off-site sources and have demonstrated that no undue risks exist for the design of those facilities. For the purposes of this evaluation, it was assumed that all sites can be developed to meet the exclusionary criteria outlined in 10CFR100. The suitability of the four sites was, therefore, evaluated based on the relative number and distance of potential off-site man-related hazards. The evaluation addressed both existing and projected hazards within a 5-mile radius of the sites.

GGNS:
The GGNS site is located in a rural area of Mississippi along the Mississippi River. Potential accidents involving hazards due to potential river and highway transportation accidents, pipeline explosions, aircraft accidents, releases from off-site facilities, fires, etc. were previously evaluated (Reference 1, Section 2.2).

Only 1 industrial facility exists within a 5-mile radius of GGNS. The nearest US highway is located approximately 5 miles east of the site. Transportation of bulk quantities of chemicals, fuels, and other hazardous materials occurs on the Mississippi River about 1.5 miles west of the GGNS facility. No significant number of airports, mining operations, military installations, or pipelines occur in the area. The potential for transportation related accidents on the river, highways, and railways in the area were demonstrated to pose no significant hazard to the operation of GGNS.

No significant future expansion of transportation systems or industrial facilities is anticipated near GGNS.

JAF:
The JAF site is located on the shore of Lake Ontario seven miles northeast of the city of Oswego, New York. Several major industries exist in the area (Reference 2, Section 2.1). The Nine Mile Point Nuclear Station is located approximately one half mile west and an aluminum rolling mill is located approximately 2 miles west of the JAF site. Approximately 20 major industrial facilities occur in the county.

Few transportation corridors exist in the area. The nearest US highway is located about 4 miles south of the site. A major east-west railway line is located 1.5 miles south of the site. Lake Ontario is a major shipping avenue for regional and international commerce.

No major airports or military installations exist in the area.

PNS:
There are no airports, military installations, chemical plants, gas pipelines, or large manufacturing facilities within a 5-mile radius of the PNS site (Reference 3, Section, 2.2). One petroleum storage facility is located 4 miles west of the site. The nearest major highway (State No.3) is located over 3 miles to the west. Ships traveling between Boston and the Cape Cod area pass within approximately 3 miles east of the site. An analysis of potential hazards in the area demonstrated that none of the identified hazards pose any credible risk to the site.

RBS:
Several major industrial sites exist within a 5-mile radius of the RBS site (Reference 4, Section 2.2). These facilities include mining, paper, recycled rubber tire products, and electrical power industries. No chemical manufacturing, refineries, major airports, or military installations occur within this area.

The RBS site has several pipeline, railway, and highway transportation systems in the area. Two natural gas pipelines are located approximately 2 miles east of the plant. Three railway lines exist in the area with the closest located approximately one half mile southwest of the RBS site. The principal highway in the area is US 61 which passes within 1 mile of the site. The RBS site is located 2 miles east the Mississippi River on which significant quantities of hazardous materials are transported.

No major expansion of transportation, chemical storage, or industrial facilities are projected for the area.

Relative Scores:
Ranking of the four sites was performed based on a comparison of potential off-site man-made hazards. Sites with the lowest number of potential hazards were assigned a value of 5.

GGNS	JAF	PNS	RBS
5	3	4	3

References:

1. Entergy Operations, Inc. Updated Final Safety Analysis Report: Grand Gulf Nuclear Station (Rev. 0).
2. Entergy Nuclear Northeast. 2001. James a. Fitzpatrick Final Safety Analysis Report Update.
3. Entergy Nuclear Generating Company, 1999. Pilgrim Nuclear Power Station Preliminary Safety Analysis Report.
4. Gulf States Utilities Company and Cajun Electric Power Cooperative,1999. River Bend Station Updated Safety Analysis Report.

A.1.5 - Extreme Weather

Extreme weather conditions of interest are related to specific PPE criteria regarding tornado design, wind and precipitation (Reference 1, Section 3.1.1.5).
During the review of available sources of meteorological information on the sites, no information was found that indicated the four sites could not meet the exclusionary and avoidance criteria specified for ALWR composite PPE values.
With respect to suitability of the four sites, extreme weather included the evaluation of extreme wind speed conditions. Extreme wind is a meteorological term for the maximum anticipated wind speed that is maintained over an interval of time in which the wind can travel one mile. This term is also referred to as the fastest-mile wind speed. Available extreme wind values were obtained from government sources and SAR's for the respective sites. When available, other information regarding potential high wind speed conditions was included in the evaluation.

GGNS:
The nearest weather station to GGNS is located in Jackson, MS, approximately 50 miles NE of the facility. Over a 14-year period of record, an extreme wind value of 68 mph was reported for the area (Reference 2).

The fastest-mile winds at 50-year and 100-year return frequencies are 66 mph (Reference 3) and 61 mph (Reference 4, Section 2.3.1.2.9), respectively.

Based on NOAA Storm Prediction Center, the GGNS site is located in a region of the south central US where 6-10 recorded tornados/1000 square miles have been recorded (Reference 5). Based on historic tornado occurrences, the NOAA forecast for the annual average number of tornadoes/10,000 miles in Mississippi is 5.0 (Reference 6).

JAF:

The nearest weather stations to the JAF site are located in Rochester and Syracuse. The Rochester station is located approximately 90 miles WSW from the facility. The Syracuse station is located approximately 35 miles south of JAF. For the period of record 1941–1981, observed extreme wind values of 73 mph were reported at the Rochester station (Reference 1) and 63 mph at the Syracuse weather station (Reference 7).

Estimated fastest-mile values for the JAF site are 62, 75, and 82 mph at return periods of 10, 50, and 100 years, respectively (Reference 8, Section 2.2.2.2).

Based on NOAA Storm Prediction Center, the JAF site is located in a region of the northeastern US where <1 tornadoes/1000 square miles have been recorded (Reference 5). Based on historic tornado occurrences, the NOAA forecast for the annual average number of tornadoes/10,000 miles in New York is 1.2 (Reference 6).

Note: Depending on the level of conservatism used to calculate snow loading, the JAF site could possible exceed the PPE exclusionary criteria value of 50 lbs/ft^2. A record 72-hr snowfall event of 75-90 inches occurred in 1965 (FSAR Section 2.2.2.2).

PNS:

Extreme winds in the area are generally related to hurricanes and northeasters. Massachusetts coastal areas have been affected several times in recent history by extreme hurricanes, which have winds > 136 mph. Since 1938, six extreme hurricanes have affected the area.

The Boston and Blue Hill weather stations, located in the Boston metropolitan area northwest of PNS, are the nearest weather stations to PNS that provide extreme weather data. High winds conditions reported for the Boston station include a maximum sustained 5-minute wind speed value of 87 mph (Reference 9, Table 2.3-18). At the Blue Hill station during a 53-year period of record, a fastest mile wind speed value of 121 mph was recorded (Reference 10).

NOTE: Information regarding the specific wind loading models and meteorological terms used to calculate the PPE value of 110 mph were not available during this evaluation. Depending on the specific definition of "basic wind speed" used in these design calculations, the extreme wind value of 121 mph may exclude the PNS site from further consideration.

The Blue Hill weather station is located in Milton, MA and is closer to PNS than the Boston weather station. Wind data for the Blue Hill weather station was not addressed in the PNS PSAR.

Little information was identified regarding the estimated return frequencies for extreme wind conditions. According to J.L. Gross *et al* (Reference 3), the estimated 50-year wind for Boston is 84 mph.

Based on NOAA Storm Prediction Center, the PNS site is located in a region of the northeastern

US where 1-5 tornadoes/1000 square miles have been recorded (Reference 5). Based on historic tornado occurrences, the NOAA forecast for the annual average number of tornadoes/10,000 miles in Massachusetts 3.8 (Reference 6).

RBS:

The nearest weather station to RBS is located in Baton Rouge, LA, approximately 30 miles SE of the facility. For a period of record 1963 to 1981, an observed extreme wind value was 58 mph was reported (Reference 1).

For the period of record 1949 – 1978, a maximum hourly wind speed of 58 mph was recorded at the Ryan Airport, located 19 miles SE of the site (Reference 11, Section 2.3.1.2.1). Fastest-mile wind speeds of 50, 65, 70, 90, and 100 mph may be expected to occur in the site area at intervals of approximately 2, 10, 25, 50, and 100 years, respectively (Reference 11, Section 2.3.1.2.1).

Based on NOAA Storm Prediction Center, the RBS site is located in a region of the south central US where 6-10 tornadoes/1000 square miles have been recorded (Reference 5). Based on historic tornado occurrences, the NOAA forecast value for the annual average number of tornadoes/10,000 miles in Louisiana is 5.6 (Reference 6).

Relative Suitability Ranking:

Ranking of the four sites was performed based on a comparison of recorded extreme wind (fastest-mile) values, projected extreme winds at various return frequencies, and severe storm records. This information is summarized below.

Site	Fastest Mile (mph)	Fastest Mile (mph) (at 100-yr return)	Fastest Mile (mph) (at 50-yr return)	Tornado Frequency
GGNS	68	61	66	5
JAF	73/63	82	75	1.2
PNS	87/121	-	84	3.8
RBS	58	100	90	5.6

Sites with the lowest wind speed values were given a relative ranking score of 5.

GGNS	JAF	PNS	RBS
5	4	3 or X?	3

References:

1. EPRI. 2001. Siting Guide: Site Selection and Evaluation Criteria for an Early Site Permit Application.
2. US Department of Commerce. 1982. National Oceanic and Atmospheric Administration. Comparative Climatic Data for the United States Through 1981.

3. J.L. Gross, et al, 1995. Extreme wind estimates by the conditional mean exceedance procedure. US Department of Commerce, National Institute of Standards and Technology. Report NISTIR 5531.
4. Entergy Operations, Inc. 199?, Updated Final Safety Analysis Report – Grand Gulf Nuclear Station.
5. Federal Emergency Management Agency, 1998. Taking shelter from the storm. FEMA report 320, first edition.
6. National Oceanic and Atmospheric Administration, undated. Annual Average Number of Tornadoes per 10,000 square miles by State, 1950-1995. Online source at http://lwf.ncdc.noaa.gov/oa/climate/severeweather/ tornadoes.html.
7. National Oceanic and Atmospheric Administration, undated. Wind – Maximum Speed. Online source at http://lwf.ncdc.noaa.gov/oa/climate/ online/ccd/maxwind.html.
8. Entergy Nuclear Northeast. 2001. James a. Fitzpatrick Final Safety Analysis Report Update.
9. Entergy Nuclear Generating Company. 1999. Pilgrim Nuclear Power Station Preliminary Final Safety Analysis Report.
10. US Department of Commerce. 1968. National Oceanic and Atmospheric Administration, Climatic Atlas of the United Sates, reprinted 1979.
11. Gulf States Utilities Company and Cajun Electric Power Cooperative,1999.River Bend Station Updated Safety Analysis Report.

A.2.1 Population

The purpose of this section is to evaluate the suitability of the candidate sites with respect to the population density in the vicinity of the sites. For the purposes of this evaluation, it was assumed the existing licensed units at the four candidate sites meet the population density conditions codified in 10CFR100.21. These conditions are:

- the sites have exclusion area authority,
- a low population zone exists beyond the exclusion area, and
- sufficient distance exists to high population centers.

As outlined in Regulatory Guide 4.7, low population areas are preferred and low population zones should have densities less than 500 people per square mile (Reference 1).

Available census data regarding total population, population densities, and population-center distances were reviewed for the candidate sites. Data were obtained in Section 2.1 of the respective site Final Safety Analysis Reports and on-line data from the US Census Bureau.

<u>Total Population</u>

Total resident populations and population densities projected for the year 2020 at radii of 10, 20 and 50 miles are summarized in the table below.

Distance (miles)	Site	Total Population (2020 Projection)	Population Density (population/mile^2)
0-10	GGNS	8,800	28
	JAF	72,797	232
	PNS	207,588	661
	RBS	37,649	120
0-20	GGNS	29,800	24
	JAF	111,410	89
	PNS	854,008	680
	RBS	219,143	174
0-50	GGNS	382,000	49
	JAF	1,797,820	229
	PNS	7,297,038	930
	RBS	1,324,133	169

Population projections were obtained from the four site FSAR's. These values include only resident population totals. With the exception of the PNS site, which has a significant seasonal non-resident population in the summer, the sites had low transient population totals.

__Population Centers__

A population center is a densely populated area with a resident population over 25,000. Distances to the nearest population center for the four candidate sites are shown below. Population center estimates were obtained from the US Census Bureau for the years 1994-95 (Reference 2). The estimated distance to a population center was measured from the reactor center line.

Site	Nearest Population Center	Population	Approximate Distance (miles)
GGNS	Vicksburg, MS	26,800	25
JAF	Syracuse, NY	161,200	38
PNS	Plymouth, MA	51,700	4
RBS	Baton Rouge, LA	224,800	25

Relative Ranking:

The four sites were ranked according to the overall population totals within 10, 20, and 50 mile radius areas around the sites, population densities, and distances to nearby population centers. Areas with the lowest population totals, densities, and longer distances to population centers were given a ranking value of 5.

GGNS	JAF	PNS	RBS
5	4	2	4

References:

1. EPRI. 2001. Siting Guide: Site Selection and Evaluation Criteria for an Early Site Permit Application. EPRI, Palo Alto, California.

2. US Census Bureau, 2000. Population Estimates for the Years 1994-99. Available on-line at http:www.census.gov/population/estimates/metro-city/placebyst/*

A.2.2 Emergency Planning

The purpose of this section is to evaluate the suitability of the four candidate sites with respect to emergency planning characteristics of the general area around each site. (No exclusionary or avoidance criteria apply to this issue.) Of particular importance in this evaluation was a review of the total population, traffic networks, terrain features, and climatic conditions. Sites with the least constrained evacuation planning issues (lowest population, best traffic networks, lowest evacuation times, etc.) were considered the most suitable.

A summary of relative information for each site is shown in the table below.

	GGNS	JAF	PNS	RBS
Total Population (within 10-mile radius, 2020 forecast)	9,000	73,000	208,000	38,000
Total Population (within 20-mile radius, 2020 forecast)	40,000	110,000	850,000	200,000
Other population factors	LPZ population ~ 200. Low transient populations. Few schools and other institutions within 5 miles. Nearest population center (Port Gibson –3,000) 5 miles east.	LPZ (4-mile radius) population ~2000. Low transient population. Nearest population center (Oswego – 25,000) 7 miles SW.	High seasonal transient population. Significant growth rate in LPZ.	Moderate transient populations. LPZ population ~1500. Nearest population center (St. Francisville – 2,000) 4 miles NW.
Traffic networks	Exclusion area intersected by	Private road bisects site	Exclusion area	US Highway 61 approx

	state road. US Hwy 61 (Natchez Trace Pkwy) within 5 miles east of site.	connecting Hwy 104 and County Rd. 29.	intersected by county road. Hwy 3 at distance o f 5 miles. Several state roads within LPZ.	1 mile north of facility. Several state roads within LPZ.
Egress constraints	Minor egress constraint by Bayou Pierre south of site	No significant constraints.	No significant constraints.	EA egress in 15-40 minutes. Minor egress constraint by Thompson Creek east of site
Climatic conditions	No significant climatic conditions affect EP.	90" winter precipitation.	Moderate winter precipitation conditions in area.	No significant climatic conditions affect EP.
Other factors	Access to west half of EPZ across Mississippi River constrained for GGNS personnel.	Overlapping EA control with Nine Mile Point. Large LPZ (r=4 miles)	Dynamic wind conditions and complex terrain features.	Railway within EA 1 mile south of facility. Access to EPZ across Mississippi River constrained for RBS personnel

Relative Ranking Scores:

Sites with the lowest population totals and fewest egress, weather, and transportation constraints were considered to be more suitable and were assigned a score of 5.

	GGNS	JAF	PNS	RBS
Ranking Score	**5**	**4**	**3**	**4**

A.2.3 Atmospheric Dispersion

The purpose of this section is to evaluate the suitability of the four candidate sites with respect to short-term atmospheric dispersion characteristics. The efficiency of atmospheric diffusion is primarily dependent on wind speed, wind direction, and a vertical change in air temperature which affects atmospheric stability. These factors are used to calculate an atmospheric dispersion function referred to X/Q. Available information from site FSAR's (Section 2 - Meteorology) was reviewed to assess the relative atmospheric dispersion qualities of the sites. In general, areas with high winds and unstable atmospheric conditions provide higher atmospheric dispersion of pollutants have lower X/Q values and are, therefore, preferred power plant sites.

Comparable X/Q values for the exclusion area boundary and low population zones are summarized in the table below. These values were calculated by site personnel using site meteorological data for a 2-4 period of time. Values may differ at each site over time based on the annual meteorological data summaries used to calculate X/Q values.

	GGNS	JAF	PNS	RBS
Exclusion area 5% X/Q (sec/m3) for 0-2 hrs	**1.263E-3**	**1.8 E-5**	**2.91E-4**	**7.02 E-4**
LPZ 5% X/Q (sec/m3) For 0-2 hrs	**2.841E-4**	**4.0 E-6**	**5.47E-5**	**1.37 E-4**

Ranking Scores:

Sites with the lowest X/Q values were considered to be more suitable and were assigned a relative ranking score of 5.

	GGNS	JAF	PNS	RBS
Score	4	5	4	4

A.3.1 – Surface Water Radionuclide Pathway

The purpose of this section is to evaluate the four candidate sites with respect to potential liquid pathway dose consequences. (No site exclusionary or avoidance criteria apply to this issue.) Besides potential source terms, dilution in the receiving surface water body is of primary importance. Three factors considered in evaluating the potential dilution for a receiving water body are dilution capacity, baseline loadings, and proximity to consumptive users.

Dilution Capacity

Information on the radioactive source term dilution at a new power plant will be site specific. For siting consideration where such information is not available, however, surrogate parameters, representing the dilution capacity of a stream, can be used. The greater the dilution capacity of a stream, the shorter will be the mixing length downstream defined as the zone within which complete mixing of a discharge contaminant occurs.

GGNS
The average annual 7Q10 flow for the Mississippi River is 127,000 cfs at Vicksburg, MS, which is upstream from GGNS. The period of record for the data is from January 1928 to September 1976. The instantaneous minimum flow was reported as 99,400 cfs (Reference 1, p. 15).

JAF
Lake Ontario obtains its principal supply of water from the Niagara River which drains the four upper lakes. The Niagara River discharges an average of approximately 200,000 cfs to Lake Ontario. Other inflows are received from direct precipitation and smaller streams draining into the lake. The outflow from Lake Ontario, controlled by dams on the St. Lawrence River at the Authority's St. Lawrence Power Project, averages approximately 240,000 cfs (Reference 2, p. 11).

PNS
Cape Cod Bay has a surface area of approximately 365,000 acres. Except for the southeast corner of the bay, where Billingsgate Shoal is located, depths generally increase rapidly with distance from shore. The greatest depth, about 180 feet, occurs at the mouth of the bay. Approximately half the surface area of the bay has depths greater than 100 feet, and the volume-mean depth is also about 100 feet. The water volume of Cape Cod Bay is about 36,000,000 acre-feet (Reference 3, p. 2-121).

RBS
The average annual 7Q10 flow for the Mississippi River is 142,000 cfs at Talbert Landing, MS and 101,000 cfs at Red River Landing, LA, both of which are upstream from the River Bend site. The period of record for the Talbert Landing data is from October 1963 to September 1975 and the period of record for the Red River Landing data is from January 1928 to June 1963. The instantaneous minimum flow was reported as 75,000 cfs for both stations (Reference 1, p. 15 and p. 41).

Baseline Loadings

The capacity of a stream to impact health and safety of downstream consumers is related to the existing, or baseline loadings of, radionuclides that are present in the system or can be anticipated in the future.

GGNS
In 2000, GGNS personnel collected environmental samples for radiological analysis as part of the site Radiological Environmental Monitoring Program. The program compared results of indicator locations with control locations and previous studies, and concluded that overall no significant relationship exists between GGNS operation and effect on the plant environs. The 2000 data, in many cases, showed undetectable radiation levels in the environment and near background level in significant pathways associated with GGNS (Reference 4, p. i). Surface water sample results indicated that gamma radionuclides remained undetectable in the upstream and downstream Mississippi River sample locations. This is consistent with preoperational and previous operations years. Also, tritium was undetectable in the upstream and downstream Mississippi River locations (Reference 4, p. 2-4).

JAF

The analytical results from the 2000 Radiological Environmental Monitoring Program demonstrate that the routine operation of the JAF had no significant or measurable radiological impact on the environment. The results of the program continue to demonstrate that the operation of the plant did not result in a measurable dose of any significance to the general population, above natural background levels or adversely impact the environment as a result of radiological effluents (Reference 5, p 1).

PNS

In 2000, samples collected as part of the Radiological Environmental Monitoring Program at PNS continued to contain detectable amounts of naturally-occurring and man-made radioactive materials. None of the samples collected in 2000 showed any detectable activity potentially attributable to PNS operations (Reference 6, p. 31).

RBS

The 2000 Radiological Environmental Monitoring Program substantiated the adequacy of source control and effluent monitoring at River Bend Station with no observed impact of plant operations on the environment (Reference 7, p. i). No gamma-emitters were measured in any waterborne pathway samples during 2000. All measurements in surface waters were below their respective LLDs at all locations in 2000. The review of 2000 data, in many cases, showed radioactivity levels in the environment were undetectable in many locations and near background levels in significant pathways. Surface water samples were collected from two locations (indicator and control) and analyzed for gamma radionuclides and tritium. Gamma radionuclides were below detectable limits at the indicator and control locations with tritium detected at background levels at both locations.

Proximity to Downstream Users

Downstream locations of public water supply withdrawals and recreational contact were identified for each site. Sites with greater pathway lengths to users were more suitable and were assigned a score of 5.

GGNS

Several industries downstream from GGNS (river mile 406) use river water for industrial purposes. The nearest point down stream where river water is used as a public water supply source is at the Dow Chemical facility located at river mile 209, or 197 miles down stream (Reference 8, Section 2.4.1.2).

JAF

Within a 30-mile radius of JAF, two public water supplies obtain water from Lake Ontario. Both sites are located approximately 8.5 miles from the site (Reference 9, Section 2.4.2).

PNS

No public water systems are located near PNS which use Cape Cod Bay as water supply source

(Reference 10).

RBS

Downstream of RBS (river mile 262), the nearest public water supply on the Mississippi River is located at the Bayou Lafource Fresh Water District. Intake pumps for the district are located at river mile 175, or approximately 87 miles downstream from RBS (Reference 11).

Relative Score:

Based on the large water bodies at the four candidate sites, all were giver a dilution capacity ranking score of 5. Based on available information, the baseline loadings of the site are similar and no site was identified as being less suitable than the others. The sites were, therefore, given a score of 5 with respect to baseline loading characteristics. The GGNS and PNS sites were considered to be most suitable with respect to the proximity to down stream users and were giver a score of 5. The JAF site was least suitable due to the proximity of public water supplies on Lake Ontario within 8 miles of the site.

	GGNS	**JAF**	**PNS**	**RBS**
Dilution capacity	5	5	5	5
Baseline Loadings	5	5	5	5
Proximity to consumptive users	5	3	5	4
Average value	5	4.3	5	4.7
Ranking score	**5**	**4**	**5**	**4**

References:

1. State of Louisiana Department of Transportation and Development. 1980. Low-Flow Characteristics of Louisiana Streams, Water Resources Technical Report No. 22. Office of Public Works, Baton Rouge, LA.

2. New York Power Authority. 1971.Environmental Report, Operating Stage, for the James A. Fitzpatrick Nuclear Power Plant.

3. Boston Edison Company. 1974. Pilgrim Station Unit-2, Applicant's Environmental Report, Construction Permit Stage.

4. Entergy Operations, Inc. 2000. Grand Gulf Nuclear Station 2000 Annual Radiological Environmental Operating Report.

5. New York Power Authority. 2000. Annual Radiological Environmental Operating Report, January 1, 2000 - December 31, 2000 for James A. Fitzpatrick Nuclear Power Plant.

6. Entergy Nuclear Generating Company. 2000. Pilgrim Nuclear Power Station, Radiological Environmental Monitoring Program Report, January 01 - December 31,

2000.

7. Entergy Operations, Inc. 2000. River Bend Station Annual Radiological Environmental Operating Report for 2000.

8. Entergy Operations, Inc. 199_, Updated Final Safety Analysis Report – Grand Gulf Nuclear Station

9. Entergy Nuclear Northeast. 2001. James A. Fitzpatrick Final Safety Analysis Report Update.

10. Entergy Nuclear Generating Company. 1999. Pilgrim Nuclear Power Station Final Safety Analysis Report.

11. Gulf States Utilities Company and Cajun Electric Power Cooperative. 1999. River Bend Station Updated Safety Analysis Report.

A.3.2 Groundwater Radionuclide Pathway

The purpose of this section is to evaluate the four candidate sites with respect to the relative vulnerability of shallow groundwater resources to potential contamination.

All candidate sites overlie aquifers that have not been designated by EPA's (1986) classification scheme. EPA guidelines were, however, used to assign a designation to candidate site aquifers. In addition, the relative vulnerability of these aquifers to groundwater pollution was evaluated using a standard numerical ranking system called DRASTIC (Aller et al. 1987). Sites considered most suitable are those which are least vulnerable to groundwater contamination within a 2-mile radius of a site.

Class I groundwater is addressed as an avoidance criteria (EPRI 2000). This classification includes groundwater resources of unusually high value. They are highly vulnerable to contamination and are irreplaceable sources of drinking water and or ecologically vital. In the areas near the four candidate sites, the only aquifer meeting this definition is the Plymouth-Carver Aquifer, which underlies the PNS site. This aquifer has been designated as a "sole source aquifer" by EPA Region 1 because it supplies drinking water for nearly all residents within the area, there exists no reasonably available alternative water supply, and it is highly vulnerable to contamination (EPA 1990, p. 3). Groundwater underlying the remaining candidate sites are either currently used or are potential sources of drinking water, hence, they would be considered Class II aquifers according to the EPA classification guidelines.

The DRASTIC evaluation was completed using site specific data, where available, or data from published sources. The most important variables that control the groundwater pollution potential are:

- D–Depth to water,
- R–Recharge (net),
- A–Aquifer media,
- S–Soil media,
- T–Topography (slope),
- I–Impact of the vadose zone,
- C–Conductivity (hydraulic) of the groundwater flow system.

DRASTIC assigns a weighted numeric value to each characteristic, depending on its relative contribution to risk of groundwater contamination. This results in a numeric ranking for each site, allowing the sites to then be ranked in order of suitability. The higher an area scores on the DRASTIC index, the more susceptible a site is to groundwater contamination. Following is a summary of the DRASTIC evaluations.

GGNS

DRASTIC Variable	Range and Source of Information	Weight	Rating	Number
Depth to water	10–15 ft bgs on west and 40–70 ft on east (MPL et al.1978, Fig. 2.4-14)	5	9–5	45–25
Net Recharge	0–0.17 in/yr (USGS 1998, p. F7, Fig.22)	4	1	4
Aquifer Media	Unconsolidated to poorly consolidated, discontinuous beds of sand, silt, clay, and some gravel comprising alluvial and terrace deposits and deposits of the Catahoula Formation (USGS 1998, p. F12, Mississippi Power & Light et al. 1978, p. 2.4-7)	3	6	18
Soil Media	silt loam (USDA 1963)	2	4	8
Topography	0–2% in west and 2–5% in east (MPL et al. 1978, Fig. 2.4-14)	1	10–9	10–9
Impact Vadose Zone	sand and gravel west to silt and clay east (MPL et al. 1978, p. 2.4-7)	5	6–3	30–15
Hydraulic Conductivity	300–700 gpd/ft^2 (USGS 1998, p.F14 Fig. 55)	3	4	12
			Drastic Index	**91–127**

JAF

DRASTIC Variable	Range and Source of Information	Weight	Rating	Number
Depth to water	15-30 ft bgs (estimated from NYPA 1971, p. 11).	5	7	35
Net Recharge	2 in/yr (NYPA 1973, p. 2-11)	4	3	12
Aquifer Media	Bedded sandstone of Oswego Formation (USGS 1995, p.M25; NYPA 1973, p.2-14)	3	5	15
Soil Media	Sandy loam (Entergy Nuclear Northeast 2001, p. 2.5-1)	2	6	12
Topography	0 to 2% (calculated from NYPA 1973, p.2-7)	1	10	10
Impact Vadose Zone	Thin layer (0 to 12') of till consisting of a mixture of silt, sands, gravel, and cobbles and some clay and unsaturated sandstone (Entergy Nuclear Northeast 2001, p. 2.5-1)	5	6	30
Hydraulic Conductivity	1–100 gpd/ft^2 (Freeze & Cherry 1979, p.29)	3	1	3
			Drastic Index	**117**

PNS

DRASTIC Variable	Range and Source of Information	Weight	Rating	Number
Depth to water	5-15 ft bgs (inferred from USGS 1977 and EPA 1990, p.3).	5	9	45
Net Recharge	24 in/yr (EPA 1990, p. 4)	4	9	36
Aquifer Media	Plymouth-Carver Aquifer consisting of sand and gravel (USGS 1995, p.M4; EPA 1990; Entergy Nuclear Generating Company 1999, p. 2.5-9)	3	8	24
Soil Media	silt to stony, sandy loam (USDA 1969)	2	5	10
Topography	0 to 3% (USDA 1969, Sheet 34W and USGS 1977)	1	9	9
Impact Vadose Zone	Sandy silts and silty, clayey sands (Entergy Nuclear Generating Company 1999, p. 2.5-9)	5	6	30
Hydraulic Conductivity	411-2,341 gpd/ft^2 (EPA 1990, p. 4)	3	8	24
			Drastic Index	**178**

RBS

DRASTIC Variable	Range and Source of Information	Weight	Rating	Number
Depth to water	40–60 ft bgs (Gulf States Utilities Company et al. 1999, Fig. 2.4-50)	5	5	25
Net Recharge	0.66–3.0 in/yr (USGS 1998, p. F7, Fig. 22)	4	3	12
Aquifer Media	clay, silt, sand and gravel of the Upland Terrace Aquifer which is hydraulically connected to the overlying Alluvial Aquifer (Gulf States Utilities Company et al. 1999, p. 2.4-51,-57 and -63)	3	8	24
Soil Media	silt loam (USDA 1992, p. 23)	2	4	8
Topography	0–2 % (USGS 1994)	1	10	10
Impact Vadose Zone	Predominantly clay in the alluvium (Gulf States Utilities Companies et al. 1999, p.2.4-63)	5	3	15
Hydraulic Conductivity	1,229 gpd/ft^2 (Calculated from transmissivity & thickness data, Gulf States Utilities Company et al. 1999, p. 2.4-61 and 2.4-62.)	3	8	24
			Drastic Index	**118**

DRASTIC indexes for all typical hydrogeologic settings range from 65 to 223 (Aller et al. 1987, p. 82). This range of indexes was used to develop a ranking system to compare vulnerability of candidate sites, as follows:

DRASTIC Index Range	Relative Vulnerability	Rank
65–98	Low	5
98–132	Low to Moderate	4
132–166	Moderate	3
166–199	High	2
199–233	Very High	1

Based on these DRASTIC Index Ranges for qualitative vulnerability, candidate sites were ranked as follows:

Candidate Site	DRASTIC Rating	Rank
James A. Fitzpatrick	117	4
Pilgrim	178	2
Grand Gulf	95–127	4
River Bend	118	4

References:

1. Aller, L., Bennett, T., Lehr, J., Petty, R. and G. Hackett. 1987. DRASTIC: A Standardized System for Evaluating Ground Water Pollution Potential Using Hydrogeologic Settings. EPA/600/2-87/035, June 1987.

2. Entergy Nuclear Northeast. 2001. James A. Fitzpatrick Final Safety Analysis Report Update.

3. EPA. 1990. Sole Source Aquifer Designation for the Plymouth-Carver Aquifer, Massachusetts, 55 FR 32137, available through the World Wide Web at http://www.epa.gov/region01/eco/drinkwater/soleplym.html

4. EPA. 1986. Guidelines for Groundwater Classification Under the EPA Groundwater Protection Strategy, Office of Groundwater Protection.

5. Freeze, A. and J. Cherry. 1979. Groundwater. Prentice-Hall, Inc., Englewood Cliffs, NJ.Gulf States Utilities Company and Cajun Electric Power Cooperative. 1999. River Bend Station Updated Safety Analysis Report.

6. Mississippi Power & Light Company (MPL) and Middle South Entergy, Inc. 1978. Grand Gulf Nuclear Station Units 1 and 2, Final Environmental Report.

7. New York Power Authority (NYPA). 1973. Final Environmental Statement related to the Operation of James A. Fitzpatrick Nuclear Power Plant.

8. New York Power Authority. 1971. Environmental Report, Operating Stage for the James A. Fitzpatrick Nuclear Power Plant.

9. NRC. 1981. Final Environmental Statement Related to the Operation of Grand Gulf Nuclear Station, Units 1 and 2.

10. USDA. 1992. Soil Survey of West Feliciana Parish.

11. USDA. 1969, Soil Survey of Plymouth County, Massachusetts, Sheet 34 W.

12. USDA. 1963. Soil Survey of Claiborne County, Mississippi.

13. USGS. 1998. Groundwater Atlas of the United States, Segment 5, Arkansas, Louisiana, Mississippi. Hydrologic Investigations Atlas 730=F.

14. USGS. 1995. Ground Water Atlas of the United States, Segment 12, Connecticut, Maine, Massachusetts, New Hampshire, New York, Rhode Island, and Vermont. Hydrologic Investigations Atlas 730-M.

15. USGS. 1992. Elm Park, Louisiana quadrangle mao. 7.5 minute series, 1:24,000.

16. USGS. 1977. Manomet, Massachusetts quadrangle map, 7.5 minute series, 1:24,000.

A.3.3 Air Radionuclide Pathway

The purpose of this section is to address the suitability of the four candidate sites with respect to two air radionuclide pathway characteristics. (No exclusionary or avoidance criteria apply to air radionuclide pathways at the sites.) The two suitability characteristics are topographic effects and atmospheric dispersion.

Information regarding topography and air dispersion characteristics of the sites is summarized in the table below. Annual average X/Q values were unavailable for several of the candidate sites. Because air dispersion characteristics are very site specific, substituting data from regional weather stations was not attempted for this evaluation. Instead, air dispersion ranking scores from Section A.2.3 (Atmospheric Dispersion) are included below. These scores addressed short-term air dispersion characteristics (5% X/Q for 0-2 hrs at the EAB and LPZ boundaries), while annual average X/Q values are outlined in Reference 5 (Section 3.1.3.3.2) for this criterion. Although the specific atmospheric dispersion parameters in Section A.2.3 differ from the ALWR annual average X/Q values, they can provide relative information on the air dispersion characteristics of the sites.

	GGNS	JAF	PNS	RBS
Topographic effects	Site located on the east bank of the Mississippi River in rolling bluff hills. East bank terrain ranges in elevation from 80-200'. West bank is Mississippi River alluvium with little topographic relief. Typical low wind speeds and uniform wind directions. No significant topographic features effects on air dispersion reported. (Reference 1)	Site located on south shore of Lake Ontario. Gentling rolling terrain east, south, and west of the site. Predominant winds from SW – S. No significant topographic features or lake effect noted to effect air dispersion. (Reference 2)	Site located on the south shore of Cape Cod Bay. Adjacent to site on the south is Pine Hills ridge with maximum elevation of 400'msl. Relatively high speeds, unstable from S and W. Frequency of offshore and onshore winds are 63 and 36 percent, respectively. (Reference 3)	Site is located on the east bank of the Mississippi River in heavily wooded area of rolling hills at elevation 100'. West side of plant site along alluvium at elevation 35'. No significant topographic features to effect air dispersion noted. (Reference 4)
Topographic effects score	5	5	4	5
Atmospheric dispersion score (from Section A.2.3)	4	5	4	4
Average score	4.5	5	4	4.5
Ranking score	**4**	**5**	**4**	**4**

References:

1. US Nuclear Regulatory Commission. 1981. Final Environmental Statement related to the operation of Grand Gulf Nuclear Station, Units 1 and 2.

2. New York Power Authority. 1971.Environmental Report, Operating Stage, for the James A. Fitzpatrick Nuclear Power Plant

3. Entergy Nuclear Generating Company, 1999. Pilgrim Nuclear Power Station Final Safety Analysis Report.
4. Gulf States Utilities Company and Cajun Electric Power Cooperative.1999. River Bend Station Updated Safety Analysis Report.
5. EPRI, 2001. Siting Guide: Site Selection and Evaluation Criteria for an Early Site Permit Application.

A.3.4 Air - Food Ingestion Pathway

A potential exposure pathway for nuclear power plants is the emission of radionuclides into the food chain on local crops and pastures. Radiological doses and dose commitments resulting from a nuclear plant are well and known and documented. While the operational impacts on the public through food pathway exposures are negligible, sites with lower amounts of crop and pasture land uses are considered to be more suitable. No exclusionary or avoidance criteria apply to this issue.

General information regarding crop lands and pastures near the sites is summarized in the table below.

	GGNS	JAF	PNS	RBS
General agricultural land use	Located in an intensive area o f agricultural activity. Within a 10-mile radius, soy beans, wheat, corn, and rice production occurs.. Majority of crop lands west of site in LA Mississippi River alluvium. Cattle, beef, and poultry production common on east side of river in Coastal Plain. (Reference 1)	Area within 10-mile radius mainly covered in forests and shrub lands. Small farms and gardens common. Local area and Oswego County in long-term agricultural decline due to poor soil and urbanization. Less than 10% of area suitable for agriculture. (Reference 2)	Area within a 10-mile radius of site is forested, with urban development along coast, and low crop production and pasture use. Approximately 7% of area was in farm use during site construction. Majority of crop production related to cranberry industry and small gardens. High rate of urbanization. (Reference 3)	1100 acres of plant site was originally prime farm land. Majority of intensive crop production area is west of site in Mississippi River. (Reference 4)
Relative Score	**4**	**5**	**5**	**4**

References:

1. US Nuclear Regulatory Commission. 1981. Final Environmental Statement related to the operation of Grand Gulf Nuclear Station, Units 1 and 2.
2. New York Power Authority. 1971.Environmental Report, Operating Stage, for the James A. Fitzpatrick Nuclear Power Plant
3. Entergy Nuclear Generating Company, 1999. Pilgrim Nuclear Power Station Final Safety Analysis Report.
4. Gulf States Utilities Company and Cajun Electric Power Cooperative.1999. River Bend Station Updated Safety Analysis Report.

A.3.5 Surface Water - Food Radiological Pathway

In addition to potential surface water pathways addressed in Section A.3.1 (Surface Water Radiological Pathway) and Section A.3.2 (Groundwater Radionuclide Pathway), this section addresses the specific use of irrigation water by downstream locations as a potential pathway for potential exposure. Sites with the fewest number of downstream irrigation uses are more suitable. No exclusionary or avoidance criteria apply to this issue (Reference 1).

GGNS
While some use of the Mississippi River as a source of water of irrigation water may occur, no significant amount of use for this purpose is anticipated downstream of GGNS (Reference 2, Section2.1.3.6).

JAF
No withdrawal of Lake Ontario water for irrigation use near the JAF site was reported (Reference 3). No agricultural practices, which would demand large volumes of surface water for irrigation, were identified in the JAF area

PNS
Water from Cape Cod Bay is not suitable for irrigation purposes.

RBS
While some use of the Mississippi River as a source of water for irrigation may occur, no significant amount of use for this purpose is anticipated downstream of RBS (Reference 4).

Relative Ranking Scores:

The four sites were ranked according to the potential for downstream users to pump water for irrigation purposes. Because the water bodies in area of the PNS and JAF sites have a very low potential for use as a source of irrigation water, these sites were considered to be most suitable and were given scores of 5. Because the Mississippi River is heavily farmed downstream of the GGNS and RBS sites and because the river could be used for irrigation purposes, these sites were considered less suitable and were giver lower ranking scores.

	GGNS	**JAF**	**PNS**	**RBS**
Ranking Score	**4**	**5**	**5**	**4**

References:

1. EPRI, 2001. Siting Guide: Site Selection and Evaluation Criteria for an Early Site Permit Application. EPRI Report.
2. Mississippi Power & Light Company, Middle South Entergy, Inc.1978. Grand Gulf Nuclear Station Units 1 and 2, Final Environmental Report.

3. Entergy Nuclear Northeast. 2001. James a. Fitzpatrick Final Safety Analysis Report Update.
4. US Nuclear Regulatory Commission. 1985. Final Environmental Statement related to the operation of River Bend Station.

A.3.6 - Transportation Safety

Potential impacts from plant operations on transportation safety could occur as a result of increased hazards from cooling towers. Both natural draft and mechanical cooling towers can increase area fogging conditions ice formation on local roads and highways. Sites with high frequencies of naturally-occurring fog and ice events will likely be more adversely affected by cooling tower operations. The purpose of this section is to evaluate the suitability of the four candidate sites with respect to potential to create fog and ice hazards to local transportation. No exclusionary or avoidance criteria apply to this issue.

Relative information regarding existing fog and ice conditions at the sites is summarized in the table below.

	GGNS	JAF	PNS	RBS
Fog conditions	Highly variable fog history. Moderate and heavy fog conditions occur annually in area for 90 and 50 hrs, respectively. No off-site fogging conditions from cooling tower are likely. (Reference 1)	No significant fogging conditions reported for JAF area.	Some sea breeze fumigation and “steam” fog near discharge canal. No significant fogging reported. Cooling tower plume could impact Highway 3A over Pine Hills. (Reference 3)	Cooling tower plume has caused increase in ground level fog 0.5% of the time to a distance of 1200'. No off-site fogging conditions likely. (Reference 4)
Ice conditions	Several short duration ice storms occur each year. Occasionally, severe ice storm with significant accumulation. Low probability of cooling tower affects on off-site icing conditions. (Reference 1)	The JAF area receives approximately 90” of snow/ice annually. Prevalent wind direction from SW-SE. On shore impacts likely limited to JAF site. (Reference 2)	Ice glazing occurs several times each winter. Significant ice storms not uncommon. Possible plume impact on Highway 3A on Pine Hills. (Reference 3).	Cooling tower icing conditions have potential to occur to a distance of 1200’. No off-site icing conditions likely. (Reference 4)
Relative score	**5**	**5**	**4**	**5**

References:

1. US Nuclear Regulatory Commission. 1981. Final Environmental Statement related to the operation of Grand Gulf Nuclear Station, Units 1 and 2.
2. New York Power Authority. 1971.Environmental Report, Operating Stage, for the James A. Fitzpatrick Nuclear Power Plant
3. Entergy Nuclear Generating Company, 1999. Pilgrim Nuclear Power Station Final Safety Analysis Report.
4. Gulf States Utilities Company and Cajun Electric Power Cooperative.1999. River Bend Station Updated Safety Analysis Report.

B.1.1 Disruption of Important Species/Habitats (Aquatic/Marine)

The purpose of this section is to evaluate the candidate sites with respect to potential construction related impacts on aquatic or marine ecology. Regulatory Guide 4.7 defines important plant and animal species if one or more of the following conditions apply.

- the species is commercially or recreationally valuable,
- the species is officially listed as endangered or threatened,
- the species effects the well being of another species within (1) or (2) above,
- the species is a critical component of the structure and function of a valuable ecosystem, or
- the species is a biological indicator of radionuclides in the environment.

Of particular concern are potential impacts to habitat areas used by important species. These areas include those used for:

- breeding and nursery,
- nesting and spawning,
- wintering, and
- feeding.

The following siting criteria were used to evaluate the four candidate sites.

- Exclusionary – Designated critical habitat of endangered species
- Avoidance – Areas where threatened and endangered species are known to occur.
- Suitability – Areas where limited potential impact is expected

No site specific data was obtained regarding the presence of federally listed threatened and endangered species and their suitable habitats on the 4 candidate sites. In most instances, the county (or parish) was the smallest geographic unit that was addressed by data pertaining to federally listed threatened and endangered species. For the purposes of this evaluation, a subjective determination was made regarding a definition of typical habitat for certain animal species. In the case of sea turtles, for example, they were classified as “marine” on that basis that most of their life cycle is spent in oceanic water and with only limited time periods spent on terrestrial habitats. The habitat of Plymouth red-bellied turtle is here defined as freshwater aquatic. The typical habitat of bog turtles, on the other hand, is here described as terrestrial wetlands rather than freshwater aquatic (although it is known that these turtles frequent both habitat types). Site scores are based on a compilation of information at the county level from several cited sources.

GGNS

The State of Mississippi has a total of 41 federally listed species, *i.e.*, 37 animals and 4 plants (Reference 1, page 1). Of those 37 animal species, 22 species are predominantly associated with freshwater or marine aquatic habitats (Reference 6). Of those 22 animal species, 2 species (pallid sturgeon and bayou darter) have been reported from freshwater aquatic habitats within Claiborne County, Mississippi (Reference 9, page 1), and one of those same species (pallid sturgeon) also has been reported from nearby Tensas Parish, Louisiana (Reference 10, page 12).

JAF
JAF is located on the shores of Lake Ontario, and the study area supports commercial populations of two fish species, i.e., alewife and rainbow smelt, that are considered of minor commercial value. These two species are used commercially as animal feed, and rainbow smelt also has sport fishing value (Reference 7, pages 2.3-4 through 2.3-13).

The State of New York has a total of 26 federally listed species, *i.e.*, 20 animals and 6 plants (Reference 2, page 1). Of those 20 animal species, 11 species are predominantly associated with freshwater or marine aquatic habitats. Of those 11 animal species, none have a potential for occurrence in freshwater aquatic habitats within the study area (Reference 11, pages 1-2).

PNS
PNS is in proximity to Cape Cod Bay, which supports several species of high commercial value including the benthic fin fishes (cod, haddock, winter flounder, and hake) and American lobster. Impingement and entrainment impacts on fish populations in the area receive significant attention from regulators and the general public. Losses to important commercial and recreational species (Atlantic aelwife, winter flounder, tautog, and weakfish) were demonstrated to be significant at Brayton Point power plant located at Mt. Hope Bay, Massachusetts (Reference 13, page 318). The Cape Cod Bay area also supports a commercially viable population of Irish moss, which is an alga harvested commercially as the source of carageenan, a substance used in making paints, medicines, and foods (Reference 8, pages 14-15).

The State of Massachusetts has a total of 23 federally listed species, *i.e.*, 20 animals and 3 plants (Reference 3, page 1). Of those 20 animal species, 10 species are predominantly associated with freshwater or marine aquatic habitats. Of those 10 species, only 1 species (Plymouth red-bellied turtle), has been reported within the Town of Plymouth (Reference 5, page 9; Reference 12, page 13). An additional 9 federally listed species, i.e., sea turtles and whales, are known from ocean waters of the State (Reference 3, page 1).

RBS
The State of Louisiana has a total of 28 federally listed species, *i.e.*, 24 animals and 4 plants (Reference 4, page 1). Of those 24 animals, 13 species are predominantly associated with freshwater or marine aquatic habitats (Reference 6). Of those 13 animal species, 1 species (pallid sturgeon) has been reported from within the study area, i.e., in the Mississippi River of West Feliciana Parish (Reference 10, page 12).

Relative Score:

No information was discovered which would indicate any of the four sites exceed the exclusionary or avoidance criteria for important species or their habitats. The suitability of four sites was evaluated and the sites with the lowest potential for significant impacts on important aquatic or marine species or their habitats were given a relative ranking value of 5. RBS and GGNS were determined to be the most suitable sites based on their minimal potential impacts on commercial fisheries, threatened and endangered species, and aquatic habitats. PNS was the least suitable site based on its greater potential for adverse impacts on important marine species of commercial and recreational value.

GGNS	JAF	PNS	RBS
5	3	2	5

References:

1. US Fish and Wildlife Service. 2001. Threatened and endangered species system. Listing by State and Territory. Printed on 10/18/2001. <http://ecos.fws.gov/webpage_usa_lists.html?state=MS>

2. US Fish and Wildlife Service. 2001. Threatened and endangered species system. Listing by State and Territory. Printed on 10/18/2001. <http://ecos.fws.gov/webpage_usa_lists.html?state=NY>

3. US Fish and Wildlife Service. 2001. Threatened and endangered species system. Listing by State and Territory. Printed on 10/18/2001. <http://ecos.fws.gov/webpage_usa_lists.html?state=MA>

4. US Fish and Wildlife Service. 2001. Threatened and endangered species system. Listing by State and Territory. Printed on 10/18/2001. <http://ecos.fws.gov/webpage_usa_lists.html?state=LA>

5. State of Massachusetts. 2001. Massachusetts list of endangered, threatened, and special concern species. Rare species by town: O through P (with fact sheets pertaining to individual species). Printed on 10/18/2001. <http://www.state.ma.us/dfwele/dfw/nhesp/nhrare.htm>

6. US Fish and Wildlife Service. 1992 (and with periodic looseleaf updates). Endangered and threatened species of the Southeast United States (The Red Book). Ecological Services, Division of Endangered Species, Southeast Region.

7. Entergy Nuclear Northeast. 1982. James A. Fitzpatrick Nuclear Power Plant. FSAR Update.

8. US Atomic Energy Commission. 1972. Final Environmental Statement, Pilgrim Nuclear Power Station.

9. US Fish and Wildlife Service. 2001. Endangered and threatened species of Mississippi (federally listed species by counties). Printed on October 24, 2001. <http://southeast.fws.gov/jackson/MsCo_TE.html>

10. Louisiana Department of Environmental Quality. 2001. Parish/species list. Printed on October 24, 2001.
<http://www.deq.state.la.us/permits/lpdes/msgp-noi.pdf>

11. US Fish and Wildlife Service. 1999. Federally listed and proposed endangered and threatened species in New York. Printed on 10/24/2001.
<http://www.ci.nyhc.ny.us/html/doh/pdf/wnv/a3d2.pdf>

12. Virginia Tech Conservation Management Institute. 2001. Species account for Plymouth red-bellied turtle. Printed on 10/24/2001.
http://fwie/fw/vt.edu/WWW/esis/lists/e155001.htm

13. US EPA, 2001. National Pollution Discharge Elimination System – Regulations addressing Cooling Water Intake Structures. Prepublication version dated November 9, 2001.
http://www.epa.gov/waterscience/316b/nov9ph1pre.pdf

B.1.2 – Botton Sediment Disruption Effects

The purpose of the section is to evaluate the potential short-term impacts to aquatic/marine resources resulting from construction related dredging activities at the candidate sites. The evaluation sought available data on the amount of contaminated sediments near the candidate sites and the grain size of sediments in the area. In general, sites with the lowest concentration of heavy metals and toxic organic compounds and the highest sediment grain size are considered to be the most suitable.

Little information exists regarding the site specific level of sediment contamination that exists in water bodies near the candidate sites. The majority of the available information was obtained from the EPA 's National Sediment Quality Survey (Reference 1). Information in the EPA report addresses sediment contamination levels as Tier I (adverse impacts to aquatic life are probable) and Tier II (adverse impacts to aquatic life are possible but infrequent). Using best professional judgment, the following evaluation considered the results of the EPA's Tier I/Tier II study results to determine the relative contamination potential for the candidate sites.

No information regarding sediment grain size was obtained for this evaluation. Because sediment grain size is highly variable, even within a small area of coastline or river reach, the following evaluation of potential bottom sediment disruption effects was limited to available information regarding sediment contamination levels in principle water bodies at the four sites.

GGNS

The EPA reported that 85% of the sediment sampling stations in the lower Mississippi River (downstream of Memphis, TN) were ranked as either Tier I or Tier II (Reference 1) . The Yazoo River merges with the Mississippi River just upstream from GGNS. The Yazoo River basin is an area with significant levels of metal and organic pesticide sediment contamination (Reference 2).

JAF

The Oswego River enters Lake Ontario at Oswego, NY, about 7 miles southwest of the JAF site.

The Oswego River is the second largest tributary of Lake Ontario and is a recognized source of pollution that has caused environmental problems for the lake. The EPA has classified the Oswego River/Harbor area as an “Area of Concern” due to contamination from PCBs, dioxin, nutrients, organic pesticides, and metals (Reference 3). The major impairments to Lake Ontario are restrictions on fish and wildlife consumption, restrictions on dredging activities, degraded aesthetics, and loss of fish and wildlife habitat. Available information indicates that there is a high potential for contaminated sediments to exist in the vicinity of the JAF site.

PNS
Available information indicates that there is a moderate potential for contaminated sediments to exist in the vicinity of the PNS site. The majority of concerns about degraded water quality and contaminated sediments in Massachusetts coastal waters are focused on the Boston Bay area located north of the PNS site and in the Buzzards Bay/Nantucket Sound area located south of Cape Cod. Some evidence shows the existence of sediment contamination in the Cape Cod area near the PNS site (References 1 and 2).

RBS
Available information indicates that there is a moderate potential for significant sediment contamination to exist in the Mississippi River near the RBS site (References 1 and 2). The majority of lower Mississippi River sediment samples showed some level of contamination from metals and organic pesticides.

Relative Score:
Contaminated sediments at levels of regulatory concern may exist at each of the four candidate sites. The estimated potential for contaminated sediments to effect the cost and schedule of any construction related dredging operations was based on the limited information available and professional judgment Using this process, the PNS site was considered to be the most suitable site and was assigned a relative ranking value of 5.

Grand Gulf	River Bend	Fitzpatrick	Pilgrim
3	3	2	5

References:

1. EPA 1997. The Incidence and Severity of Sediment Contamination in Surface Waters of the United States. Volume 1: National Sediment Quality Survey. Office of Science and Technology. EPA 823-R-97-006, September 1997.

2. EPA 1997. The Incidence and Severity of Sediment Contamination in Surface Waters of the United States. Volume 2: Data Summaries for Areas of Probable Concern. Office of Science and Technology. EPA 823-R-97-007, September 1997.

3. EPA, 2001. Great Lakes Areas of Concern: Oswego River, New York. Printed on 9/20/01 from http://www.epa.gov/glnpo/aoc/oswego.html.

B.2.1 Disruption of Important Species/Habitats and Wetlands

The purpose of this section is to evaluate the candidate sites with respect to potential construction related impacts on important species and terrestrial ecology. Regulatory Guide 4.7 defines important plant and animal species if one or more of the following conditions apply.

- the species is commercially or recreationally valuable,
- the species is officially listed as endangered or threatened,
- the species effects the well being of another species within (1) or (2) above,
- the species is a critical component of the structure and function of a valuable ecosystem, or
- the species is a biological indicator of radionuclides in the environment.

Of particular concern are potential impacts to habitat areas used by important species. These areas include those used for:

- breeding and nursery,
- nesting and spawning,
- wintering, and
- feeding.

The following siting criteria were used to evaluate the four candidate sites.

- Exclusionary – Designated critical habitat of endangered species
- Avoidance – Areas where threatened and endangered species are known to occur.
- Suitability – Areas where limited potential impact is expected

The four candidate sites were evaluated with respect to information available on important species/habitats, groundcover, and mapped wetlands within a 4-mile radius.
During this evaluation, no information was obtained which would indicate any of the four sites exceeded the exclusionary and avoidance criteria outlined above. This following evaluation was, therefore, focused on the relative suitability of each site.

Information on important species was obtained from natural resource offices in the respective states. Because little up-to-date information was available on site ground cover characteristics, a subjective review of early environmental reports was utilized. Wetland information was obtained from the National Wetlands Inventory (NWI) maps published by U.S. Fish and Wildlife Service (Reference 13). The extent of mapped wetland areas that occur within a 2 mile (near field) and 4 mile (far field) radius of the sites was reviewed.

GGNS
The State of Mississippi has a total of 41 federally listed species, *i.e.*, 37 animals and 4 plants (Reference 1, page 1). Of those 37 animal and 4 plant species, a total of 15 species are primarily associated with upland and wetland terrestrial habitats (Reference 6). Of those 15 animal species, 1 species (Louisiana black bear) has been reported as occurring within upland and wetland terrestrial habitats within Claiborne County (Reference 9, page 1). In nearby Tensas Parish, Louisiana, there is a potential for Louisiana black bear and two bird species (Arctic peregrine falcon and bald eagle) for a total of 3 animal species (Reference 10, page 12). None of the 4 federally listed plant species

for Mississippi have been reported from Claiborne County (Reference 9, page 1), and suitable habitat appears to be absent for all 4 species. Federally listed plant species also have not been reported from Tensas Parish, Louisiana (Reference 10, page 12), and no evidence has been seen that would support the presence of potential habitat for any of the state's 4 federally listed species.

Four NWI maps (Davis Island, St. Joseph, Yokena, and Port Gibson) were reviewed for the presence of wetlands within a 2 mile and 4 mile radius of the GGNS site. The Mississippi River lies to the west of the site within the 2 mile and 4 mile radius of the site. Black River lies to the north of the site within the 4 mile radius and Bayou Pierre lies to the south of the site within the 2 and 4 mile radii. Approximately 20 percent of the total area in a 2 mile radius, and approximately 25 percent of the total area in a 4 mile radius of the GGNS site were mapped as wetland.

JAF

The State of New York has a total of 26 federally listed species, *i.e.*, 20 animals and 6 plants (Reference 2, page 1). Of those 20 animal and 6 plant species, a total of 16 species are primarily associated with upland and wetland terrestrial habitats. Of the 10 animal species, 4 species (bog turtle, bald eagle, piping plover, and Indiana bat) were considered to have a potential for occurrence within the study area (Reference 11, page 1). None of the 6 federally listed plant species have been reported from within Oswego County, and no evidence has been seen that would support the presence of potential habitat for any of these 6 species within the study area (Reference 11, page 2).

Four NWI maps (Texas, West of Texas, Oswego East, and New Haven) were reviewed for the presence of wetlands within a 2 mile and 4 mile radius of the JAF site. Lake Ontario borders this site to the north. To the south of the site, approximately 20 percent of the total area in a 2 mile radius, and approximately 20 percent of the total area in a 4 mile radius from the existing plant were mapped as wetland.

PNS

The cranberry industry of Massachusetts is centered in the southeastern part of the state, which includes the study area. Water quality and water preservation programs are important to cranberry growers, because cranberry growers own 22% of all surface water in Plymouth County. Any activity that threatens impacts to surface water has a potential to adversely impact the area's economy (Reference 13, pages 1-4).

The State of Massachusetts has a total of 23 federally listed species, *i.e.*, 20 animals and 3 plants (Reference 3, page 1). Of those 20 animal and 3 plant species, a total of 12 species are primarily associated with upland and wetland terrestrial habitats. Of those 9 animal species, 3 species (piping plover, least tern, and roseate tern) have been reported to occur within the Town of Plymouth (Reference 5, page 9; Reference 12, page 13). None of the 3 federally listed plant species have been reported, and suitable habitat is not expected for them within the study area (Reference 5, pages 8-10).

The Manomet, Massachusetts NWI map was reviewed for the presence of wetlands within a 2 mile and 4 mile radius of the PNS site. Cape Cod Bay borders this site to the north. To the south of the site, approximately 6 percent of the total area in a 2 mile radius, and approximately 8 percent of the total area in a 4 mile radius from the existing plant were mapped as wetland.

RBS

The State of Louisiana has a total of 32 federally listed species, *i.e.*, 28 animals and 4 plants (Reference 4, page 1). Of those 28 animal and 4 plant species, a total of 14 species are primarily associated with upland and wetland terrestrial habitats (Reference 6). Of those 10 animal species, 1 species (American alligator) has been reported as representing a permanent resident at the site (Reference 10, page 4-18). Two additional species (Arctic peregrine falcon and Louisiana black bear) have been reported as occurring within West Feliciana Parish (Reference 10, page 12). None of the 4 federally listed plant species for Louisiana has been reported from West Feliciana Parish (Reference 10, page 12), and there is no evidence that suitable habitat exists within the study area for any of the 4 species.

The St. Francisville and New Roads, LA NWI maps were reviewed for the presence of wetlands within a 2 mile and 4 mile radius of the site. The Mississippi River lies to the east of the site within the 2 mile and 4 mile radii that were reviewed. Approximately 25 percent of the total area in a 2 mile radius, and approximately 50 percent of the total area in a 4 mile radius from the existing plant were mapped as wetland.

Relative Score:

GGNS was determined to be the most suitable sites based on its lowest potential for impacts on important species, wetlands and other terrestrial habitats. PNS was the least suitable site based on its greater potential for impacts.

GGNS	JAF	PNS	RBS
5	4	3	4

References:

1. US Fish and Wildlife Service. 2001. Threatened and endangered species system. Listing by State and Territory. Printed on 10/18/2001. <http://ecos.fws.gov/webpage_usa_lists.html?state=MS>

2. US Fish and Wildlife Service. 2001. Threatened and endangered species system. Listing by State and Territory. Printed on 10/18/2001. <http://ecos.fws.gov/webpage_usa_lists.html?state=NY>

3. US Fish and Wildlife Service. 2001. Threatened and endangered species system. Listing by State and Territory. Printed on 10/18/2001. <http://ecos.fws.gov/webpage_usa_lists.html?state=MA>

4. US Fish and Wildlife Service. 2001. Threatened and endangered species system. Listing by State and Territory. Printed on 10/18/2001. <http://ecos.fws.gov/webpage_usa_lists.html?state=LA>

5. State of Massachusetts. 2001. Massachusetts list of endangered, threatened, and special

concern species. Rare species by town: O through P (with fact sheets pertaining to individual species). Printed on 10/18/2001.
<http://www.state.ma.us/dfwele/dfw/nhesp/nhrare.htm>

6. US Fish and Wildlife Service. 1992 (and with periodic looseleaf updates). Endangered and threatened species of the Southeast United States (The Red Book). Ecological Services, Division of Endangered Species, Southeast Region.

7. Entergy Nuclear Northeast. 1982. James A. Fitzpatrick Nuclear Power Plant. FSAR Update.

8. US Atomic Energy Commission. 1972. Final Environmental Statement, Pilgrim Nuclear Power Station.

9. US Fish and Wildlife Service. 2001. Endangered and threatened species of Mississippi (federally listed species by counties). Printed on October 24, 2001.
<http://southeast.fws.gov/jackson/MsCo_TE.html>

10. Louisiana Department of Environmental Quality. 2001. Parish/species list. Printed on October 24, 2001.
<http://www.deq.state.la.us/permits/lpdes/msgp-noi.pdf>

11. US Fish and Wildlife Service. 1999. Federally listed and proposed endangered and threatened species in New York. Printed on 10/24/2001.
<http://www.ci.nyhc.ny.us/html/doh/pdf/wnv/a3d2.pdf>

12. Virginia Tech Conservation Management Institute. 2001. Species account for Plymouth red-bellied turtle. Printed on 10/24/2001.
http://fwie/fw/vt.edu/WWW/esis/lists/e155001.htm

13. Cowardin, L.M., V. Carter, F. Golet, and E. LaRoe.1979. Classification of Wetlands and Deepwater Habitats of the United States. U.S. Fish and Wildlife Service. 103 pp.

B.2.2. Dewatering Impacts on Wetlands

The purpose of this section is to evaluate the four sites with respect to potential impacts from construction related dewatering activities on area wetlands. The evaluation included a review of information related to the depth of the water table and the distance to nearby wetlands.

A determination of the extent of wetland acreage within the study area was limited. National Wetland Inventory maps were used as the basis for determining wetland acreage. Those maps include numerous areas that do not represent jurisdictional wetlands under Section 404 of the Clean Water Act, which contributed to the difficulty in making an estimate of wetland acreage. Moreover, those maps were based primarily on interpretation of aerial photography, and the amount of field validation that was performed varies according to region of the country and local terrain. Site Environmental Reports and other documents developed during the early stages of site licensing were also reviewed. These documents may not necessarily reflect existing wetland conditions at the sites.

GGNS
The western parts of the study area, i.e., on the side of the Mississippi River, have estimated depths to water table of 10 to 15 feet. The eastern parts of the study area show evidence of perched ground water at depths ranging from 40 to 70 feet (Reference 1, Section 2.4.13).

Within a 2-mile radius of the existing facility, it is estimated that up to 25% of the land surface may be occupied by wetlands (Reference 2). The existing facility's land base includes 19 small ponds, 3 of which are natural and support submergent, emergent, and floating vegetation (Reference 2, page 4-15).

JAF
The study area exhibits estimated depths to water table of 15 to 30 feet (Reference 4, page 11).

Within a 2-mile radius of the existing facility, it is estimated that up to 20% of the land surface may be occupied by wetlands (Reference 2).

PNS
Estimated depths to water table of 0 to 5 feet were inferred (Reference 5).

Within a 2-mile radius of the existing facility, it is estimated that no more than 6% of the land surface may be occupied by wetlands (Reference 2).

USGS topographic maps indicate the presence of numerous cranberry bogs in the area to the south of the existing Pilgrim facility. These areas are not shown on the NWI wetland maps, indicating they represent "farmed wetlands", which are subject to regulation by the US Department of Agriculture. Dewatering of the landscape in conjunction with construction activities would have a detrimental effect on these agricultural wetland systems. The fact that 22% of the surface waters in Plymouth County is owned by cranberry grower interests attests to the potential area economic impacts that could be related to dewatering activities.

The federally listed Plymouth red-bellied turtle is known only from freshwater ponds in the Town of Plymouth. Any extensive drawdowns to the Plymouth aquifer has a potential to affect the turtle's food supply and habitat (Reference 6, page 14).

RBS
The depth to alluvial groundwater at the site ranges from approximately 40 to 60 feet (Reference 7, Section 2.4.13).
Within a 2-mile radius of the existing facility, it is estimated that up to 25% of the land surface may be occupied by wetlands.

Relative Ranking Score:

RBS was determined to be the most suitable site with regard to effects of dewatering, as based on depth of water table. PNS was the least suitable site based on its extremely shallow water table.

GGNS and RBS were determined to be the most suitable sites based on proximal wetlands. PNS was the least suitable site based on its greater potential for adverse dewatering impacts to the cranberry industry and the federally listed Plymouth red-bellied turtle.

Sites with the lowest potential for adverse impacts on area wetlands from on-site construction related dewatering activities were assigned a ranking value of 5.

GGNS	JAF	PNS	RBS
5	4	3	5

References:

1. Entergy Operations, Inc., 199?. Updated Final Safety Analysis Report – Grand Gulf Nuclear Station, Revision 10.

2. Cowardin, L.M., V. Carter, F. Golet, and E. LaRoe.1979. Classification of Wetlands and Deepwater Habitats of the United States. U.S. Fish and Wildlife Service. 103 pp.

3. US Nuclear Regulatory Commission. 1981. Final Environmental Statement related to the operation of Grand Gulf Nuclear Station, Units 1 and 2.

4. New York Power Authority. 1971.Environmental Report, Operating Stage, for the James A. Fitzpatrick Nuclear Power Plant.

5. EPA. 1990. Sole Source Aquifer Designation for the Plymouth-Carver Aquifer, Massachusetts, 55 FR 32137, available through the World Wide Web at http://www.epa.gov/region01/eco/drinkwater/soleplym.html

6. Virginia Tech Conservation Management Institute. 2001. Species account for Plymouth red-bellied turtle. Printed on 10/24/2001. http://fwie/fw/vt.edu/WWW/esis/lists/e155001.htm

7. Gulf States Utilities Company and Cajun Electric Power Cooperative. 1999. River Bend Station Updated Safety Analysis Report

B.3.1 Thermal Discharge

No exclusionary or avoidance criteria apply to condenser cooling water system thermal discharges on receiving water bodies (Reference 1, Section 3.2.3.1). The purpose of this section is to address the relative suitability of the four candidate sites with respect to potential thermal impacts. Three specific thermal impact issues were considered:

- impact on migratory species,
- disruption of important species and habitats, and
- impact on water quality of the receiving water body.

The plant parameter envelope for ALWR's includes values for both closed-cycle and once-through cooling water systems (Reference 1, Section 3.2.3.1.2). Gaining regulatory approval for once-through cooling water systems in the future will be challenging. In December 2001, the EPA will publish a final regulation, which affects the location, design, construction, and capacity of intake structures for new power plants (Reference 2). While the EPA rule will strongly encourage the use of closed-cycle designs to reduce adverse cooling water system impacts, once-through designs will still be allowed in limited situations. For this suitability evaluation, both closed-cycle and once-through designs were considered in ranking the four sites.

An important consideration in evaluating the suitability of the four sites was the design of condenser cooling system used by the existing unit at each site. Relative information on existing cooling systems is summarized in the table below.

Site	Description	Makeup flow (gpm)	Discharge flow (gpm)	Thermal Discharge Concerns
GGNS	Cooling tower w/groundwater makeup. Blowdown to Mississippi River.	20,000	10,000	Insignificant thermal and ecological impact on Mississippi River.
JAF	Once-through on Lake Ontario	370,000	370,000	No significant thermal and ecological concerns. Once-through discharge from Nile Mile Point and degraded water quality in area are potential complicating factors.
PNS	Once-through on Atlantic Ocean	340,000	340,000	No significant concerns with thermal impacts. Major concerns limited to entrainment impact on flounder fishery. Complex NPDES permitting situation

				for facility.
RBS	Cooling tower w/ makeup from and blowdown to Mississippi River.	15,000	5,000	Insignificant thermal and ecological impact on Mississippi River.

Relative Suitability Scores:

All of the candidate sites are located on large bodies of water. The Mississippi River, Lake Ontario, and the Atlantic Ocean would likely provide sufficient heat rejection capacity for a new unit without having significant thermal impacts to aquatic/marine ecology and water quality. No information was discovered during the evaluation which revealed any concerns with significant thermal impacts from the existing units. Even in a restrictive regulatory environment, these water bodies should provide power plant designers with a wide range of feasible cooling water system alternatives.

The sites were ranked equally suitable with respect to thermal discharges from closed-cycle cooling systems. When once-through cooling water systems are considered, however, some of the sites were more suitable. The PNS and JAF sites were ranked lower than the GGNS and RBS. The JAF site has two power plant once-through cooling water systems operating in the area. The PNS has site has several important commercial and recreation species and a more complex regulatory environment. (Supporting information on species of interest in the vicinity of the four sites is included in Section B.1.1- Disruption of Important Species/Habitats.) The Mississippi River has high flow and fewer ecological concerns from thermal impacts for the GGNS and RBS sites.

Ranking of the four sites with respect to the potential thermal discharge impacts on migratory species, important species/habitats, and water quality is summarized below.

Potential Thermal Discharge Impact	**Cooling System Design**	**GGNS**	**JAF**	**PNS**	**RBS**
Migratory species	Closed-cycle	5	5	5	5
Important species/habitats	Closed-cycle	5	5	5	5
Water quality	Closed-cycle	5	5	5	5
Migratory species	Once-through	5	4	3	5
Important species/habitats	**Once-through**	5	4	2	5
Water quality	Once-through	5	3	5	5

	Average score	5.0	4.3	4.1	5.0

References:

1. EPRI, 2001. Siting Guide: Site Selection and Evaluation Criteria for an Early Site Permit Application. EPRI Report.
2. EPA, 2001. Fact sheet: cooling water intake structures at new facilities – final rule. EPA-821-F-01-017.

B.3.2 - Entrainment and Impingement

No exclusionary or avoidance criteria apply to entrainment and impingement impacts from the operation of condenser cooling water systems (Reference 1, Section 3.2.3.1). The purpose of this section is to address the relative suitability of the four candidate sites with respect to potential entrainment and impingement impacts.

Background

When cooling water is pumped from water bodies, several environmental impacts can occur. Entrainment refers to the removal of small, drifting organisms with the cooling water. Small fish, fish eggs, phytoplakton, zooplankton, and other aquatic/marine organisms experience high mortality rates as they pass through cooling water pumps and heat exchangers. Impingement refers to larger organisms that are screened out of the cooling water at the intake structure. Impinged organisms can include large fish, crustaceans, turtles, and other aquatic/marine organisms that can not avoid high intake velocities near the intake structure and are trapped on the intake screens.

Concerns about entrainment and impingement losses are resource dependent and vary on a site-to-site basis. Typically, power plants with once-through cooling water systems have higher entrainment and impingement impacts than power plants with closed-cycle cooling water systems. The EPA will issue a final rule in December 2001 affecting the design of intake structures for new power plants (Reference 2). These rules will encourage the use of close-cycle systems. Developers of new power plants who choose certainty and faster permitting over greater design flexibility, will be encouraged to limit intake water capacities and velocities and incorporate specific intake screen designs to reduce entrainment and impingement losses.

Relative Suitability Scores:

The four candidate sites were evaluated with respect to relative potential for entrainment and impingement impacts for both closed-cycle and once-through cooling water systems.

GGNS
This site is located on the Mississippi River, which has a low potential for entrainment and impingement impacts. Several existing Entergy fossil and nuclear power plants have a long history

with once-through cooling water systems on the Mississippi River. Few, if any, entrainment or impingement concerns have occurred at these facilities.

JAF

The JAF site has low entrainment and impingement impacts from the operation of a once-through cooling water system (Reference 3, Section 2.3.4). Impacts to alewife and rainbow smelt populations from a third once-through cooling water system in the Nine Mile Point-JAF area will likely require detailed study and will be difficult to justify.

PNS

The state and federal regulatory environment for this site is burdensome. There is a long history of concerns from regulators with the existing level of entrainment impact on flounder populations (Reference 4). Additional impacts from even a new closed-cycle cooling system will likely require detailed analysis. Obtaining regulatory approval for another once-through cooling water system is probably unachievable.

RBS

This site is located on the Mississippi River, which has a low potential for entrainment and impingement impacts. Existing Entergy fossil and nuclear power plants with once-through cooling water systems on the Mississippi River have few, if any, entrainment or impingement concerns at these facilities.

A summary of the relative ranking scores for the four sites is shown in the table below. Sites with the lowest potential impact were assigned a value of 5.

Potential Impact	**Cooling System Design**	**GGNS**	**JAF**	**PNS**	**RBS**
Entrainment	Closed-cycle	5	4	3	5
Impingement	Closed-cycle	5	5	5	5
Entrainment	Once-through	5	3	1	5
Impingement	Once-through	5	4	3	5
	Average score	**5.0**	**4.0**	**3.0**	**5.0**

References:

1. EPRI, 2001. Siting Guide: Site Selection and Evaluation Criteria for an Early Site Permit Application. EPRI Report.
2. EPA, 2001. Fact sheet: cooling water intake structures at new facilities – final rule. EPA-821-F-01-017.
3. Entergy Nuclear Northeast. 2001. James a. Fitzpatrick Final Safety Analysis Report Update.
4. Personal communication, November 8, 2001. Telephone conversation between R. Buckley (Entergy Services, Inc.) and Bob West (FTN Associates, Ltd.).

B.3.3 – Dredging/Diposal Effects

The purpose of the section is to evaluate the four sites for potential environmental impacts related to maintenance dredging at the intake structure. Sites with high levels of contaminated sediment deposition at the intake structure will experience higher maintenance costs for the removal and disposal of the dredged material.

No specific exclusionary or avoidance criteria apply to this issue. The following evaluation, therefore, is a summary of available information related to the relative suitability of the sites. Two factors were considered in performing the evaluation.

- The level of upstream contamination, and
- The rate of sedimentation at the site.

As addressed in Section B.1.2 (Contaminated Sediments), no site-specific information about the level of sediment contamination at the sites was identified. Results in Section B.1.2 were based on EPA data, which addressed general trends in levels of contamination in the water bodies at the four candidate sites. The JAF (Reference 2, Section 2.3.3.2) and PNS (Reference 3, Section 2.5) sites are located on rocky/sandy coastlines and were assumed to have lower fine sediment deposition rates than the GGNS and RBS located on the Mississippi River.

Based on available information, the sites were ranked according to the expected levels of contamination and sedimentation rates for the general area of the four sites. Sites with the lowest concentration of heavy metals and toxic organic compounds and the lowest sediment rates are the most suitable and were assigned a score of 5. The results are summarized in the table below.

Criteria	GGNS	JAF	PNS	RBS
Upstream contamination sources	4	3	5	4
Sedimentation rate	3	5	5	3
Ranking value	3.5	4.0	5.0	3.5

References:

1. EPRI, 2001. Siting Guide: Site Selection and Evaluation Criteria for an Early Site Permit Application. EPRI Report.
2. Entergy Nuclear Northeast. 2001. James a. Fitzpatrick Final Safety Analysis Report Update.
3. Entergy Nuclear Generating Company, 1999. Pilgrim Nuclear Power Station Preliminary Safety Analysis Report.

B.4.1 – Drift Effects on Surrounding Areas

The purpose of this task is to evaluate the relative suitability of the four candidate sites with respect to potential concerns with cooling tower drift effects. This evaluation considered the potential effects on surrounding areas and the suitability of the cooling water source (Reference 1). This issue does not apply to sites for which once-through cooling water systems are selected.

Cooling Tower Drift

In every cooling tower, there is a loss of water to the environment in the form of pure water, which results from the evaporative cooling process. This evaporated water leaves the tower in a pure vapor state, and thus presents no threat to the environment. Drift, however, is the undesirable loss of liquid water to the environment, via small unevaporated droplets that become entrained in the exhaust air stream of a cooling tower. These water droplets carry with them minerals, debris and microorganisms and water treatment chemicals from the circulating water, thus potentially impacting the environment. High drift losses are typically caused by fouled, inefficient or damaged drift eliminators, excessive exit velocities or imbalances in water chemistry.

Minimizing drift losses in a cooling tower reduces the risk of impacting the environment. The principle environmental concern with cooling tower drift impacts are related to the emission and downwind deposition of cooling water salts (Reference 6). Salt deposition can adversely affect sensitive plant and animal communities through changes in water and soil chemistry.

Relative Scores

Information regarding important terrestrial and aquatic plant and animal communities, habitats, and wetlands in the vicinity of the four candidate sites were previously addressed in Section B.1.1 (Disruption of Important Species/Habitats) and Section B.2.1 (Disruption of Important Species/Habitats and Wetlands). Sites considered with the most sensitive environments were assigned lower ranking values. Sites with highest concentrations of dissolved solids and other potential contaminants in cooling tower makeup were also assigned lower ranking values. A summary of the relative ranking values are shown in the table below.

Criteria	**GGNS**	**JAF**	**PNS**	**RBS**
Important Species Habitat Areas	5	4	2	4
Source Water Suitability	4	5	2	3
Average value	4.5	4.5	2.0	3.5
Ranking Score	**5**	**5**	**2**	**4**

The GGNS and JAF sites were ranked higher because the local environment was considered to less sensitive to drift impacts and because cooling makeup water quality was considered to the better than the other two sites (References 2 through 5). The PNS site was ranked the lowest because of potential for significant adverse impacts to local cranberry bogs from salt water drift.

References:

1. EPRI, 2001. Siting Guide: Site Selection and Evaluation Criteria for an Early Site Permit Application. EPRI Report.
2. Entergy Nuclear Northeast. 2001. James a. Fitzpatrick Final Safety Analysis Report Update.
3. Entergy Nuclear Generating Company, 1999. Pilgrim Nuclear Power Station Preliminary Safety Analysis Report.
4. Entergy Operations, Inc. 199?, Updated Final Safety Analysis Report – Grand Gulf Nuclear Station.
5. Gulf States Utilities Company and Cajun Electric Power Cooperative, 1999. River Bend Station Updated Safety Analysis Report.
6. EPA, 1987. Memorandum from B.P. Miller to G. McCutchen dated April 10, 1987 regarding salt water drift from cooling towers. EPA Region IV, Atlanta, GA.

C.1.1 Socioeconomic – Construction Related Effects

Based on the analysis described below the site ratings for Criterion C.1.1. are as follows:

Site	Grand Gulf	River Bend	James A. Fitzpatrick	Pilgrim
Rating	3	4	4	5

DISCUSSION

Steps 1 and 2 (Exclusionary and Avoidance criteria) are not applicable to this criterion. The plant construction workforce is likely to be available at any of the sites under consideration. The issue in siting, therefore, is the potential socioeconomic impact associated with any temporary influx of construction workers who live too far away to commute daily from their residence. With respect to suitability of the four sites under consideration by Entergy, socioeconomic impacts of nuclear power plant construction are directly related to two factors:

- number of construction workers who will move into the plant site vicinity with their families; and
- capacity of the communities surrounding the plant site to absorb this new temporary (in-migrant) population.

The number of in-migrant workers is dependent on labor availability within commuting distance of the plant site. If an adequate supply of workers is available within reasonable commuting distance, few (if any) workers would choose to relocate to the site vicinity. The capacity of communities to absorb an increase in population depends on the availability of sufficient resources, such as adequate housing and community services (e.g., schools, hospitals, police, transportation systems, and fire protection) to support the influx without straining existing services. Impacts to a small community located along the commuter route(s) (e.g., food, lodging, gas, and congestion) can also be significant and should be considered. The information that should be considered in rating sites from the perspective of construction impacts includes labor requirements, location of labor pool, number of immigrants, and the economic structure of affected communities.

Before the data could be compared between sites and the sites ranked, however, certain assumptions had to be made regarding the construction labor requirements and construction schedule, labor pool, and affected area. Many of these assumptions were made without the benefit of site-specific information and may warrant future revision when site-specific data become available (i.e., when NRC website comes back on line, full NEPA documentation for original plant construction and operation can be reviewed, and/or site-specific plant personnel can be interviewed regarding actual impacts from original plant construction). For purposes of this report, assumptions are based on professional judgment and information contained in the U.S. Nuclear Regulatory Commission's *Generic Environmental Impact Statement for License Renewal for Nuclear Plants* (NUREG 1437) (May 1996). The NUREG report also included results of utility surveys, seven case studies, and plant-specific studies that examined socioeconomic impacts of original nuclear power plant construction and operation (e.g., kinds of impacts that have occurred; causal factors behind those impacts; and impact thresholds, if any). The cases included a range of plants in terms of size and population characteristics of the study areas (low, medium, high) and were supposed to represent the range of potential impacts for a nuclear power plant (NUREG/CR-2750, ORNL/NUREG/TM-22, and NUREG/CR-0916).

ASSUMPTIONS

The following assumptions were used in this analysis. According to PPE 29.4.1, Plant workforce (construction) indicates a construction workforce requirement of 2600 to 6410 persons. Construction of a nuclear power plant is very labor-intensive and that for the ALWR, skilled and unskilled construction workers would likely be needed over a 4 to 5 year period.

- Construction would begin in 2005, with a peak construction work force requirement of 3150 in 2008; this estimate is not necessarily the "worst-case" but assumed to be a "realistic" estimate for purposes of site comparison.
- Ratings are based on the assumption that only one unit would be constructed at a given site.
- Analysis assumes that no other major construction project would occur in the site vicinity concurrently with the plant construction and operation. Thus, sites were rated without consideration of potential cumulative impacts of other potential demands for labor.

METHODOLOGY

Available population/demographic, economic and community service data were obtained from the US Census Bureau, and state and local government sources for each site. The data were collected by county to determine availability of an adequate labor force within commuting distance (based on an assumed location of the labor pool). Data relating to population, labor force (manufacturing and construction), and unemployment rate were compared with the construction labor requirement to determine availability of labor.

Ratings were developed by executing the following stepwise procedure.

1. Obtain projections of the number of direct workers required (see Table 1 for the determination of In-migrant Population; these vary by site); projections were made for the peak year of construction.
2. Using work force projections, determine the number of indirect jobs that would be created as a result of the project (see Table 1). A 0.4 ratio of direct to indirect workers was used in the absence of site-specific information pertaining to the Regional Industrial Multiplier System direct/indirect ratios calculated for each plant (as found in NUREG/CR-2749).
3. Using employment projections for direct and indirect workers, calculate projected changes in local population based on patterns of worker residential location (study area), in-migration, and family size using US Census 2000 data (see Table 1). The study area is defined as the affected area in which 90% of the construction workforce is assumed to reside. The study area for each site is identified in Table 1 and accompanying footnotes.
4. Use projections of direct and indirect employment to assess the economic impacts of project construction. Economic impacts were projected by comparing estimated plant-related employment (direct and indirect) with projections of total employment for study areas during the peak year of construction (2008) (Table 2). Total employment for each study area in 2008 was projected from 1990 Census data for civilian labor force; percent growth in employment was assumed to be identical to the percent growth in study area population which, in turn, was based on actual growth rates between 1990 and 2000 (US Census). For those counties experiencing negative growth between 1990 and 2000, the growth rate between 2000 and 2008 was assumed to be zero.
5. Because so many socioeconomic impacts are driven by population growth, the next step was to use population growth projected for each study area in assessing impacts to housing and public services (e.g., schools, transportation, public safety, utilities, water and sewer facilities, health and welfare services). Population growth was based on actual growth rates between 1990 and 2000 (US Census). For those counties experiencing negative growth between 1990 and 2000, the growth rate between 2000 and 2008 was assumed to be zero.
6. Greater emphasis was placed on housing data because the data were more readily available and were more consistent between sites. In general, housing impacts are treated before public service impacts because most services generally support people by place of residence. Housing impacts were projected by comparing housing demand expected to result from in-migration of workers with projections concerning local housing markets (number of units and vacancies). See Table 3.
7. Public service impacts were measured qualitatively because consistent quantitative data were not readily available between sites.

ANALYSIS

The study of economic structure examines employment because of its pre-eminent role in determining economic well-being of an area. Specifically, impacts are determined by comparing the number of direct and indirect jobs created by plant's construction with total employment of the local study area at the time of construction. Sites were rated according to economic impacts based on the following criteria: economic effects were considered small if peak construction related employment accounted for less than 5 percent of total study area employment; moderate if it accounted for 5 to 10 percent of total study area employment; and large if it accounted for more than 10 percent of total study area employment.

In addition, housing data (i.e., total units, vacant units/vacancy rate) were collected by county to determine the ability of the community to absorb the influx of workers and their families expected to relocate. Sites were rated according to housing impacts based on the following criteria: impacts are considered small when no easily discernable change in housing availability occurs, generally as a result of a very small demand increase or a very large housing market. Moderate impacts occur when there is discernible, but short-lived reduction, in available housing units. Large impacts occur when project-related demand for housing units would result in very limited housing availability and would increase rental rates and housing values with above normal inflationary increases within a state. Moderate and large impacts are possible at sites located in rural and remote areas, at sites located in areas of slow population growth, or where growth control measures limit housing development.

Public services typically include education, transportation, public safety, social services, level of demand for public utilities, and tourism and recreation. Future impacts are based on the estimated number of in-migrating workers and on the projected state of the local infrastructure. The number of in-migrating workers accompanied by their families and their associated family sizes also are important. For education, impacts are considered small if enrollment increases 3 percent or less. Moderate impacts are associated with 4 to 8 percent increases in enrollment, and large impacts are associated within project-related enrollment increases above 8 percent. For transportation, the level of service (LOS) is a qualitative measure describing operational conditions within a traffic stream and their perception by motorists (information can be obtained from local planners, county engineers, local or state departments of transportation). Service during shift change times should be noted plant and non-plant related traffic is heaviest at these times. Impacts are considered to be large only where inadequate main local access roads are available to accommodate plant-related traffic. Impacts on public safety are considered small if there is little to no need for additional police or fire personnel, moderate if some permanent additions needed, and large if substantial increases in permanent manpower are required.
For transportation, the total number of workers is important since they will use local roads to access project site (regardless if local or in-migrated).

With respect to public services, county specific data (Census Bureau, Chambers of Commerce, State Departments of Education, etc.), were reviewed, analyzed and compared qualitatively, to the extent available and consistent between sites, to further support the site rating.

RESULTS

Summary site profile information is included in Table 4.

With respect to the economic and housing criteria defined above, results indicate that the impact on study area employment and housing from construction of a new unit would be low at each site (i.e., construction related employment is less than 5% of total study area employment; no easily discernable change in housing availability would occur because of the very small increase in demand). All sites are within reasonable commuting distance from a large city or metropolitan area (Grand Gulf - Jackson, MS; River Bend - Baton Rouge, LA; James A. Fitzpatrick - Syracuse, NY; and Pilgrim - Boston, MA). Each study area appears to have sufficient population centers within commuting distance and/or has experienced tremendous growth since 1990 such that its public services sector would be able to absorb the population in-migration associated with plant construction with minimal impact. Thus impacts would be minimal at all four sites, and differences in suitability are small.

However, a detailed comparison of all data between sites reveals slight differences which, if taken into account, could further affect site ratings in terms of providing a more detailed comparison between sites. For example, sites differ slightly with respect to the (1) projected size of the in-migration population (e.g., Grand Gulf has the highest; Pilgrim has the lowest); (2) regional population of the entire study area (e.g., Grand Gulf appears to be more rural in terms of population of study area; Pilgrim is most populated); and (3) distance from, and population of, the closest metropolitan area(s) within commuting distance (Pilgrim is closest to multiple metropolitan areas, including Brocton/Quincy/Boston, New Bedford, and even Providence, RI; Grand Gulf is closest to Jackson, MS, the capital but smallest of the metropolitan areas between the four sites). In addition, Grand Gulf also has the highest percentage of minorities and persons living below the poverty line in the study area, particularly in Claiborne County where it operates, compared to the other sites (see Environmental Justice description below). This could adversely affect the actual number of workers, especially skilled workers, available for construction. Taking these variations into account, as well as the qualitative analysis of impacts to public services and examination of the overall site profiles, the site ratings have been further adjusted, based on professional judgment. Ratings reflect the finer variations between sites - with Pilgrim having the highest rating, River Bend and James A. Fitzpatrick each at 4, and Grand Gulf rated at 3.

C.2.1 Socioeconomics – Operation

Socioeconomic impacts of operation relate primarily to the benefits afforded to local communities as a result of the plant's presence (e.g., tax plans, local emergency planning support, educational program support). These benefits tend to be a function of negotiations between the plant owner and local government; they are not indicative of inherent site conditions that affect relative suitability between sites. In addition, all four sites under consideration have previously demonstrated that their local economies can support existing plant operations, and an additional unit will not adversely affect an area that has already shown its ability to support existing units.

As a result, this criterion is not applicable to comparison of the four sites considered in this study, and, in accordance with guidance in the Siting Guide, suitability scores were not developed.

C.3.1 Environmental Justice

The purpose of the environmental justice evaluation is to ensure that the effects of proposed actions do not result in disproportionate adverse impacts to minority and low-income communities. In comparing sites, this principle is evaluated on the basis of whether any disproportionate impacts to these communities are significantly different when comparing one site to another.

The first step in this evaluation is to collect and compare population data for minorities and low-income populations across sites. With regard to the sites under consideration, minority populations are much more in evidence at Grand Gulf and River Bend than at Fitzpatrick and Pilgrim (see Table 5).

However, two additional questions comprising this evaluation also are relevant:

1. Does the proposed action result in significant adverse impacts?
2. Are impacts to minority or low-income populations significantly different between sites?

If the answer to the first question is "no" for all sites (i.e., no significant health and safety impacts are identified), then there would be no environmental justice concerns, regardless of the percentage of minority or low-income populations found within the surrounding communities of a site(s). If the answer to the first question is "yes" (i.e., significant health and safety impacts are expected), environmental justice concerns are relevant to site selection only if the answer to the second question is also "yes" (i.e., disproportionate adverse impacts on minority or low-income populations are identified at one or more sites, thereby resulting in significant differences between sites).

With regard to the sites under consideration:

- Minority populations are more in evidence at Grand Gulf and River Bend than at Fitzpatrick and Pilgrim;
- No significant health impacts to human populations were identified at any of the sites under consideration; and
- Significant minority employment exists at Grand Gulf and River Bend (based on actual employment experience); accordingly, minority and low-income populations have directly benefited from economic impacts of the existing plants. Similar beneficial economic impacts are expected to occur for additional units at these sites.

In conclusion, no significant differences in environmental justice impacts are expected between the sites under consideration because:

(1) no significant impacts to any human populations are expected to occur at any of the sites under consideration, thus there cannot be significant disproportionate impacts to minority or low-income populations, and

(2) based on actual employment experience, positive economic benefits have been shown to be available to all members of the population, without regard to income or ethnicity. NOTE: From this perspective alone, it could be argued that Grand Gulf and RBS are superior; however, this is not the thrust or intent of the environmental justice evaluation.

Based on this analysis, there is no basis for differentiation between sites from an environmental justice perspective, despite differences in the percentages of minority and low-income populations found within the surrounding communities of each site. All sites are found to be equally and highly suitable. Therefore, the site ratings are as follows:

Site	Grand Gulf	River Bend	James A. Fitzpatrick	Pilgrim
Rating	5	5	5	5

C.4.1 Land Use

Land to be used for new units is already owned by Entergy and is already zoned for uses compatible with development of a new unit; existing units are integrated into the surrounding land use patters. No significant differences in land use impact between sites under consideration are expected.

Therefore, this criterion does not provide a basis for comparison between the four sites. As a result, this criterion is not applicable to this study and is removed from further consideration. This is consistent with methods outlined in the Siting Guide.

Table 1. Determination of Project-Related In-Migrant Population

	Grand Gulf	River Bend	James A. Fitzpatrick	Pilgrim
Direct Growth				
Number of direct workers	3150	3150	3150	3150
Number of study area residents (90% of total)	2835	2835	2835	2835
Number of in-migrants (% of residents)	1418 (50%)	850 (30%)	850 (30%)	708 (25%)
Number of in-migrants with families (60%)	850	510	510	425
Average family size	3.35	3.24	3.08	3.23
Total in-migrants plus families	2849	1652	1570	1372
Number of in-migrants without families (40%)	567	340	340	283
Total direct growth	3416	1992	1910	1655
Indirect Growth				
Ratio of indirect/direct jobs	0.4	0.4	0.4	0.4
Number of indirect workers	1260	1260	1260	1260
Number of study area residents (90% of total)	1134	1134	1134	1134
Number of in-migrants (% of residents)	567 (50%)	340 (30%)	340 (30%)	284 (25%)
Number of in-migrants with families (60%)	340	102	102	71
Average family size	3.35	3.24	3.08	3.23
Number of in-migrants plus families	1140	331	314	230
Number of in-migrants without families (40%)	227	136	136	114
Total Indirect Growth	1367	467	450	344
Total Growth (direct + indirect)	**4783**	**2459**	**2360**	**2,000**

Grand Gulf (Claiborne County, MS)

- Because of its rural location, it is assumed that 50 percent of all manpower needs will be satisfied by the local population (primarily commuters from Vicksburg and Jackson); the remaining 50% will in-migrate.
- 60 percent of all in-movers will bring families
- 40 percent of all in-movers will be single
- Average family size of in-movers with families will be 3.35 persons per family (average for Claiborne County, MS)
- 90 percent of the construction workforce will reside in the study area. The study area consists of Claiborne (20%), Warren (40%), and Hinds (30%) Counties because of their proximity to the site. Warren County contains the town of Vicksburg, and Hinds County contains the majority of population for the Jackson, MS metro area. Claiborne County is bordered on the west by the Mississippi River. It was assumed that no construction workers would commute across the river from Louisiana, given the limited number of highway river crossings and the sparsely populated towns in eastern Louisiana in the vicinity of the site.
- The ratio of direct to indirect workers is 0.4.
- The percentages of workers who reside in the study area and bring families are the same for direct workers as for indirect workers.

River Bend (West Feliciana Parish, LA)

- Because of its proximity to Baton Rouge (distance), 70 percent of all manpower needs will be satisfied by the local population; the remaining 30% will in-migrate.
- 60 percent of all in-movers will bring families
- 40 percent of all in-movers will be single
- Average family size of in-movers with families will be 3.24 (average for West Feliciana Parish, LA)
- 90 percent of the construction workforce will reside in the study area. The study area consists of West Feliciana (20%), East Feliciana (5%), Pointe Coupee (5%), West Baton Rouge (5%), and East Baton Rouge Parishes (55%) because of their proximity to the site. East Baton Rouge includes the majority of population of the Baton Rouge metro area. West Feliciana also borders Mississippi (to the north) and workers could conceivably come from Mississippi (Wilkinson County). However, given the site's proximity to Baton Rouge and the low population of Wilkinson County, its inclusion would make no meaningful difference in the available labor pool. Therefore no Mississippi counties were included.
- The ratio of direct to indirect workers is 0.4.
- The percentages of workers who reside in the study area and bring families are the same for direct workers as for indirect workers.

James A. Fitzpatrick (Oswego County, NY)

- Because of its proximity to Syracuse, 70 percent of all manpower needs will be satisfied by the local population; the remaining 30% will in-migrate.
- 60 percent of all in-movers will bring families
- 30 percent of all in-movers will be single
- Average family size of in-movers with families will be 3.08 (average for Oswego County, NY)
- 90 percent of the construction workforce will reside in the study area. The study consists of Oswego (30%), Onondaga (40%), and Cayuga (20%) Counties because of their proximity to the site. Onondaga County includes the Syracuse metro area. The site is bordered on the north by Lake Ontario.
- The ratio of direct to indirect workers is 0.4.
- The percentages of workers who reside in the study area and bring families are the same for direct workers as for indirect workers.

Pilgrim (Plymouth County, MA)

- Because of its proximity to the Boston Metro Area and the large workforce available to the area, 75 percent of all manpower needs will be satisfied by the local population; the remaining 25% will in-migrate.
- 60 percent of all in-movers will bring families
- 40 percent of all in-movers will be single
- Average family size of in-movers with families will be 3.23 (average for Plymouth County, MA)
- 90 percent of the construction workforce will reside in the study area. The study consists of Plymouth (60%), Bristol (15%) and Norfolk (15%) Counties because of their proximity to the site. All of these counties are included within the Boston metro area.
- The ratio of direct to indirect workers is 0.4.
- The percentages of workers who reside in the study area and bring families are the same for direct workers as for indirect workers.

Table 2. Population and Labor

GRAND GULF (Claiborne County, MS)								
County	Claiborne	Hinds	Warren			Total	Population Influx	% of Total
Population								
Population 2000	11,831	250,800	49,644			312,275		
% growth 1990 – 2000	4.1%	-1.4%	3.7%					
% growth 2000 – 2008	3.3%	0%	3.0%					
Population 2008	12,221	250,800	51,133			314,154	4783	1.5%
Average Family Size	3.35	3.2	3.1					
Persons per square mile	24.3	288.6	84.6					
Labor								
1990 Civilian Labor Force (Total) Employed	3864 3078	124,996 114,761	21,105 19,373			149,965 137,212		
Unemployed % Unemployed	786 20%	9882 7.9%	1646 7.8%			12,314 (8%)		
1990 Employment Construction	175	5912	2624			8711	1418	16%
2008 Projected Civilian Labor Force	4155	124,996	22542			151,693	1985 (total in-migrants) 3150 (peak construction)	1.3% 2.1%

Riverbend (West Feliciana Parish, LA)								
Parish	West Feliciana	East Feliciana	East Baton Rouge	West Baton Rouge	Pointe Coupee	Total	Population Influx	% of Total
Population								
Population 2000	15,111	21,360	412,852	21,601	22,763	493,687		
% growth 1990 – 2000	17.0%	11.2%	8.6%	11.2%	1.0%			
% growth 2000 – 2008	13.6%	9.0%	6.9%	9.0%	0.8%			
Population 2008	17,166	23,282	441,751	23,545	22,945	528,689	2459	0.5%
Average Family Size	3.24	3.26	3.1	3.2	3.17			
Persons per square mile	37.2	47.2	907.4	113.1	40.9			
Labor								
1990 Civilian Labor Force (Total) Employed	3384 3055	7010 6234	188,268 172,715	8889 8039	8677 7650	216,228 197,693		
Unemployed % Unemployed	321 9%	764 11%	15,169 8%	845 9.5%	1010 11.6%	18,109 8.4%		
1990 Employment Construction	341	559	11,434	714	869	13,917	850	6.1%
2008 Projected Civilian Labor Force	4498	8497	218,567	10,517	8834	250,913	1190 (total in-migrants) 3150 (peak construction)	0.5% 1.3%

Fitzpatrick (Oswego County, NY)								
County	Oswego	Onondaga	Cayuga			Total	Population Influx	% of Total
Population								
Population 2000	122,377	458,336	81,963			662,676		
% growth 1990 - 2000	0.5%	-2.3%	-0.4%					
% growth 2000-2008	0.4%	0%	0%					
Population 2008	122,866	458,336	81,963			663,165	2360	0.36%
Average Family Size	3.08	3.07	3.04					
Persons per square mile	128.4	587.6	118.3					
Labor								
1990 Civilian Labor Force (Total) Employed	56,511 57,881	240,569 228,180	38,620 35,840			332,700 321,901		
1990 Unemployment % Unemployed	4630 8.2%	12389 5.1%	2780 7.2%			19,799 5.9%		
1990 Employment Construction	4362	11933	2360			18,655	850	4.6%
2008 Projected Civilian Labor Force	57,020	240,569	38,620			336,209	1190 (total in-migrants) 3150 (peak construction)	0.35% 0.94%

Pilgrim (Plymouth County, MA)								
County	Plymouth	Bristol	Norfolk			Total	Population Influx	% of Total
Population								
Population 2000	472,822	534,678	650,308			1,657,808		
% growth 1990 –2000	8.7%	5.6%	5.6%					
% growth [2000-2008]	7.0%	4.5%	4.5%					
Population 2008	505,919	558,738	679,572			1,744,229	2,000	0.11%
Average Family Size	3.23	3.08	3.14					
Persons per square mile	715.3	961.7	1625.8					
Labor								
1990 Civilian Labor Force Employed	231,814 215,264	264,204 241,998	348,319 328,006			844,337 785,268		
Unemployed % Unemployed	16,550 7.1%	21,423 8.1%	19,235 5.5%			57,208 6.8%		
1990 Employment Construction	14,667	15,381	18,139			48,187	708	1.5%
2008 Projected Civilian Labor Force	269,620	291,554	384,377			945,551	992 (total in-migrants) 3150 (peak construction)	0.10% 0.33%

Source: US Bureau of the Census
Population data for 2000

Table 3. Housing

Grand Gulf (Claiborne County, MS)								
County	Claiborne	Hinds	Warren			Total	Influx	% of Total
Number of Units	4252	100,287	20,789			125,328	1985	1.6%
Occupied	3685	91,030	18,756			113,651		
Vacant	567 13.3%0	9257 9.2%	2033 9.8%			11,857 9.4%		
Vacancy Rate – Home	1.1	1.9	1.5					
Vacancy Rate – Rental	8.5	11.2	12.1					
New units authorized in 1999	0	1663	39			1702		
Riverbend (West Feliciana Parish, LA)								
Parish	West Feliciana	East Feliciana	East Baton Rouge	West Baton Rouge	Pointe Coupee	Total	Influx	% of Total
Number of Units	4485	7915	169,073	8370	10,297	200,140	1190	0.59%
Occupied	3645	6699	156,365	7663	8397	182,769		
Vacant	840 18.7%	1216 15.4%	12,706 7.5%	707 8.4%	1900 18.5%	17,369 8.7%		
Vacancy Rate – Home	1.7	1.5	1.5	0.8	1.6			
Vacancy Rate – Rental	11.2	8.8	9.4	11.8	9.0			
New Units Authorized in 1999	66	1	2068	103	78	2316		
Fitzpatrick (Oswego County, NY)								
County	Oswego	Onondaga	Cayuga			Total	Influx	% of Total
Number of Units	52,531	196,633	35,477			284641	1190	0.42%
Occupied	45,222	181,153	30,558			256933 90.3%		
Vacant	7309 13.8%	15,480 7.9%	4919 13.9%			27708 9.7%		
Vacancy Rate – Home	2.2	2.0	2.0					
Vacancy Rate – Rental	9.6	9.4	10.2					
New units authorized in 1999	267	952	155			1374		

Pilgrim (Plymouth County, MA)								
County	Plymouth	Bristol	Norfolk			Total	Influx	% of Total
Number of Units	181,524	216,918	255,154			653,596	992	0.15%
Occupied	168,361	205,411	248,827			622,599		
Vacant	13,163 7.3%	11,507 5.3%	6327 2.5%			30,997 4.7%		
Vacancy Rate – Home	0.6	0.8	0.4					
Vacancy Rate – Rental	3.2	5.5	2.5					
New units authorized in 1999	1695	1792	1753			5240		

Source: US Bureau of the Census
Population data for 2000

Table 4. Schools

Grand Gulf (Claiborne County, MS)								
County/ School Districts	Claiborne	Adams	Copiah	Hinds*	Warren			Total
Total Enrollment Primary Middle High Alternate/Pri	2208 983 466 569 190	7161	5763	49,599	10,471 5330 1498 2574 237			
Total No. of Schools Primary Middle High Alter/Private	3 1 1 1				15 10 2 2 1			
Student/ Teacher Ratio	16.5/1				16/1			
Expenditure per student	$4961				$4777			

Other

Graduation rate (MS) – 74.3%

55% teachers with advanced degree; graduation rate 58.7% (Claiborne)

39% teachers with advanced degree (Warren)

Source: State of Mississippi Department of Education (1999)

Riverbend (West Feliciana Parish, LA)								
Parish	West Feliciana	East Feliciana	East Baton Rouge	West Baton Rouge	Pointe Coupee	Iberville		Total
Total Enrollment Primary Middle High Alternate/Pri Nongraded	1568 (K-8) 598 0 192	2069 (K-8) 737 655 200	39,327 (K-8) 16,418 17,509 3412	2724 (K-8) 1320 491 81	2424 (K-8) 864 1551 343	3969 (K-8) 1161 789 264		
Total No. of Schools Primary Middle High Alter/Private	3 0 1 0	2 1 2 2	67 18 19 46	5 3 3 1	6 0 3 3	3 1 5 3		
Student/ Teacher Ratio								
Expenditure per student								
Other Source: htt;://leap.nlu.edu/profiles.asp								

Fitzpatrick (Oswego County, NY)								
County	Oswego	Onondaga	Cayuga					Total
Total Enrollment Primary Middle High Alternate/Pri								
Total No. of Schools Primary Middle High Alter/Private								
Student/ Teacher Ratio								
Expenditure per student								
Other								

Pilgrim (Plymouth County, MA)								
School Districts	Plymouth	Bristol	Norfolk	Suffolk				Total
Total Enrollment Primary Middle High Alternate/Pri	8859 4456 1970 2433							
Total No. of Schools Primary Middle High Alter/Private	15 9 (K-5) 2 (6-8) 4							
Student/ Teacher Ratio								
Expenditure per student								
Other Source: http://profile.doe.mass.edu/:								

Table 5. Environmental Justice

Grand Gulf (Claiborne County, MS)						
County	Claiborne	Hinds	Warren			Total
Population	11,831	250,800	49,644			312,275
White	1796 15.2%	94,655 37.7%	27,288 55%			123,739 40%
Black	9,951 84.1%	154,304 61.5%	21,439 43.2%			185,694 59%
Asian	0.7%	0.8%	1.8%			
Hispanic						
Other						
% below poverty	28.6	18.5	16.9			State is 18.1%

Riverbend (West Feliciana Parish, LA)						
Parish	West Feliciana	East Feliciana	East Baton Rouge	West Baton Rouge	Pointe Coupee	Parish Total
Population	15,111	21,360	412,852	21,601	22,763	493,687
White	7348 48.6%	11063 51.8%	231,886 56.2%	13,561 62.8%	13,865 60.9%	265,243 (53.7%)
Black	7633 50.5%	10057 47.1%	165,526 40.1%	7,666 35.5%	8601 37.8%	199,483 (40%)
Asian	0.8%	1.1%	8585 2.1%	1.7%	1.3%	
Hispanic			7363 1.8%			
Other						
% below poverty	22.1	20.6	16.0	15.6	20.1	State is 18.4%

Fitzpatrick (Oswego County, NY)

County	Oswego	Onondaga	Cayuga			County Total
Population	122,377	458,336	81,963			662,676
White	118,918 97.2%	388,555 84.8	76,501 93.3			583,974 88%
Black	717 0.6%	43,011 9.4	3272 4.0			47,000 7%
Asian	508 0.4%	9569 2.1	348 0.4			10425 1.6%
Hispanic	1592 1.3%	11,175 2.4	1611 2.0			14378 2.2%
Other	0.5%	1.3%	0.3%			
% below poverty	14.1	12.7	12.9			15.6% (state)

Pilgrim (Plymouth County, MA)

County	Plymouth	Bristol	Norfolk	Suffolk		County Total
Population	472,822	534,678	650,308	689,807		1,657,808
White	419,370 88.7%	486,43491	578,904 89	398,442 57.7		1484,708 89%
Black	21573 4.6%	10856 2.0	20674 3.2	153,41822.2		53,103 3%
Asian	4352 0.9%	6728 1.3	35,756 5.5	48,287 7.0		46,836 2.8%
Hispanic	11,537 2.4%	19,242 3.6	11,990 1.8	107,031 15.5		42,769 2.6%
Other	0.4%	2.1	0.5	0.0		
% below poverty	8.6	11.9	5.0	20.7		10.7% (state)

Source: US Bureau of the Census
Population data for 2000

Background

This document evaluates engineering suitability factors for an Early Site Permit process. The four

(4) sites considered are Entergy's Grand Gulf Nuclear Station, Pilgrim Nuclear Power Station, James A Fitzpatrick Nuclear Power Station and River Bend Station. Each site has been evaluated on a set of pre-defined criteria as outlines in the Electric Power Research Institute's draft guidance on the Early Site Permitting process. The engineering suitability criteria primarily deal with the cost associated with preparing a site to meet certain engineering characteristics. For example, the ***pumping distance*** criterion measures the cost of construction associated with supplying a primary water supply for a power plant. It does not seek to weigh the relative value or merit of the associated water supply – such evaluation would be found in the hydrology suitability factor evaluation. The criteria are as follows:

EPRI ID#	Category	Description
D.1 Health & Safety		
D.1.1	Water Supply	raw water consumption costs; consider area rainfall history
D.1.2	Pumping Distance	pumping distance (<20mi avoidance); cost of construction
D.1.3	Flooding	cost of flood mitigation features & insurance
D.1.4	Vibratory Ground Motion	
D.1.5	Soil Stability	cost of foundation & construction requirements because of soil
D.1.6	Brownfield Site	Costs associated w/environment
D.2 Transportation & Transmission		
D.2.1	Railroad Access	cost of constructing railroad spur from access to site boundary
D.2.2	Highway Access	cost of constructing road from access to site boundary
D.2.3	Barge Access	"cost of constructing barge terminal including land/port acq/lease, relocation, dredging, infrastructure; cost of construction for barge-to-site access"
D.2.4	Transmission	
D.2.4.1	Construction	cost of total miles of transmission line to connect site to neighboring grid plus the required system upgrade costs
D.2.4.2	Losses	cost of transmission losses
D.2.4.3	Competitive Access	competitive transmission access advantage
D.3 Land Use & Site Preparation		
D.3.1	Topography	avoidance due to mountainous topology; slopes <12%/<400' relief; costs associated with site prep for grading
D.3.2	Land Rights	"cost of acquiring land area - relocation of existing structures, site due diligence (brownfield sites)"
D.3.3	Labor Rates	relative cost of labor

Summary

The following table summarizes the unweighted results of this evaluation using a relative scale of 1 to 5 – 5 representing the best site in that category and 1 representing the worst. If the sites lack statistically significant differentiation for a given parameter, more than one site may receive the same rating.

Category	GGNS	JAF	PNPS	RBS
HEALTH & SAFETY				
Water Supply	3	4	3	4
Pumping Distance	4	3	2	4
Flooding	4	3	3	3
Vibratory Ground Motion	4	5	3	4
Soil Stability	3	4	3	3
Brownfield Site				
TRANSPORTATION & TRANMISSION				
Railroad Access	3	3	2	3
Highway Access	3	3	3	3
Barge Access	3	3	3	3
Transmission Construction	4	4	5	5
Transmission Losses	4	2	5	4
Transmission Competitive Access	4	5	4	1
LAND USE & SITE PREPARATION				
Topography	4	4	3	4
Land Rights	3	3	3	3
Labor Rates	5	4	4	5

The three (3) appendices to this report contain and discuss the supporting data for each category.

References Used In the Preparation of This Report

1. River Bend Updated Final Safety Analysis Report
2. Grand Gulf Updated Final Safety Analysis Report.
3. James A Fitzpatrick Updated Final Safety Analysis Report.
4. Pilgrim Updated Final Safety Analysis Report.
5. Section A.3.21 “Groundwater Radionuclide Pathway” of FTN & Associates Site Selection Criteria report. Dated 11/19/01.
6. Section A.1.1 “Geology and Seismology” of FTN & Associates Site Selection Criteria report.

Appendix 1

D.1 HEALTH & SAFETY CRITERIA EVALUATION

D.1.1 Water Supply

River Bend and Grand Gulf have similar rainfall, floodplain and river proximity characteristics. However, Grand Gulf's distance from the Mississippi River and its use of caisson wells for water supply coupled with regional water use projections make potential new plant siting more problematic in this regard. **Thus, the anticipated costs associated with water supply design and construction are slightly higher for Grand Gulf than for River Bend.** Because of the preferential nature of water supply from Lake Ontario for construction, water quality and access versus inland water reservoirs at the Pilgrim facility, **the Fitzpatrick site is anticipated to have lower design and construction costs associated with water supply than the Pilgrim site**. Further contributing to Pilgrim's lower ranking is the result of the groundwater pollution analysis performed by FTN Associates for the aquifers surrounding the four (4) subject sites. Pilgrim ranked significantly lower with regard to aquifer pollution sensitivity which would like result in increased design and engineering and construction expense to project the water supply. [Reference 5]

D.1.1.a River Bend

The River Bend Station is located in West Feliciana Parish on the east bank of the Mississippi River approximately 24 miles north-northwest of Baton Rouge (city center), Louisiana. [Reference 1]

Maximum monthly, minimum monthly, and maximum 24-hr precipitation amounts, which are based on 28 yr of observations at Ryan Airport and on observations at other sites in the locality dating back to 1907, are provided in Table 2.3-3 (1) . A maximum monthly precipitation total of 23.73 in was recorded in May 1907 on the old Louisiana State University campus. A maximum 24-hr precipitation of 12.08 in is estimated to be equaled or exceeded approximately once every 100 yr. [Reference 1]

The average annual precipitation over the entire Mississippi River basin is about 30.8 in and varies from 21.8 in over the Missouri River Basin to 48.5 in over the Lower Mississippi River Basin. [Reference 1]

D.1.1.b Grand Gulf

The climate of southwestern Mississippi is humid and subtropical with a short cold season and a relatively long warm season. The predominant air mass over the region during most of the year is maritime tropical with origins over the Gulf of Mexico. In the winter, occasional southward movement of continental polar air from Canada bring colder and drier air into Mississippi. However, cold spells seldom last over 3 or 4 days. [Reference 2]

Mean annual precipitation in the region ranges fro about 50 inches in northwestern Mississippi to 65 inches in the southeastern part of the State. During the freeze-free season, rainfall ranges from about 24 inches in the northwest to about 37 inches in the southeast, but during winter the precipitation maximum is centered in the northwest with the minimum on the coastal counties. The fall months are the driest of the year. [Reference 2]

Average monthly precipitation follows a seasonal trend, reaching a maximum in March (5.73 inches) and a minimum in October (2.04 inches). Maximum annual precipitation has been 64.84 inches; the maximum daily amount has been 9.97 inches. [Reference 2]

The Mississippi River Commission has projected the total water needs for municipal, industrial, and power generation purposes for the Lower Mississippi Region as follows (values in millions of gallons per day (MGD)):

Need	1980	2000	2020
Municipal	17.0	25.7	38.3
Industrial	114.9	263.0	575.1
Thermoelectric Power	73.6	462.8	554.1
Rural Domestic	5.1	4.0	2.2
TOTAL	**210.6**	**755.5**	**1169.7**

[Reference 2]

D.1.1.c Fitzpatrick

Lake Ontario is the last downstream lake in the chain of the five Great Lakes and is the source of the St. Lawrence River. Lake Ontario obtains its principal supply of water from the Niagara River which drains the four upper lakes. The Niagara River discharges approximately 200,000 cfs on an annual basis to Lake Ontario. The outflow from Lake Ontario is controlled by dams on the St. Lawrence River comprising part of the St. Lawrence Power Project and averages approximately 240,000 cfs. [Reference 3]

The maximum short term (72 hr) snowfall is 75-90 in (1965). With the exception of occasional heavy snowfall, there is nothing particularly notable about precipitation at the site. [Reference 3]

The JAF site is underlain by a thin layer of sandy glacial soils overlying Oswego sandstone. The permeability of the glacial till is quite low as a result of silt and clay content and poor coefficient of sorting. The glacial till is of little hydrologic significance, due to its limited thick-ness. The Oswego sandstone is essentially impermeable; however, ground water flow through this formation does occur through joints. Pumping tests conducted during the investigation of the Nine Mile Point Nuclear Station and experience during the construction of the James A. FitzPatrick Nuclear Power Plant confirm the overall low permeability. The water table at the site slopes toward Lake Ontario at an average gradient of 37 ft per mile and the direction of groundwater movement is toward the lake. [Reference 3]

D.1.1.d Pilgrim

The climatological precipitation quantities in eastern Massachusetts show that the region does not have a wet or a dry season. Monthly averages vary from about 3 in to 4 1/2 in at Plymouth. [Reference 4]

The maximum 24-hour rainfall is 6.88 inches. [Reference 4]

D.1.2 Pumping Distance

River Bend and Grand Gulf have similar rainfall, floodplain and river proximity characteristics. However, Grand Gulf's distance from the Mississippi River and its use of caisson wells for water supply may give it some advantages over River Bend for pumping distance considerations. It is unclear if additional capacity through additional radial wells exists to allow a new site to be similarly supplied with water as the existing Grand Gulf power plant is. If this is assumed (and associated higher water supply costs appropriately considered in the preceding section), Grand Gulf may have a better orientation for pumping distance considerations. Thus, the anticipated costs associated with pumping distance design and construction are slightly higher (5-10%) for River Bend than for Grand Gulf.

D.1.2.a River Bend

For the existing power plant, the river intake screens and a barge slip are located in a man-made recession on the east bank of the Mississippi River near River Mile 262. The blowdown discharge line is located downstream of this recession to avoid recirculation of the plant effluent to the intakes. The recession is approximately 600 ft in length along the river by 450 ft in width with a dredged bottom at el -12 ft msl. The embayment design is based on model studies conducted by Colorado State University described. The entrance to the pump house structure is at el + 60 ft msl to protect the pumps and motors from the Mississippi River Project Design Flood level (el 54.5 ft msl) with wave runup. Three pumps, each sized for 16,000 gpm, are housed inside the structure. The pumps are mounted at floor el + 10 ft 2 in msl, and the pump columns extend to el -12 ft 6 in msl at the centerline of suction elbows, with the suction elbows supported at floor el -15 ft msl. River water is conveyed to the makeup water pumps by two 36-in diameter suction pipelines, each 400 ft long leading to a common manifold within the pump house structure. A wedge-wire intake screen is mounted at the entrance to each suction pipeline. The intake suction pipelines are supported in the embayment area by 21-in steel beams on 12-in steel piles, driven to the stiff clay layer. Fig. 2.4-31 shows a profile view of the intake suction pipelines and screens. At the embayment slope, the pipelines are covered by 2 ft of riprap over 1 ft 6 in of gravel to minimize erosion by river currents. [Reference 1]

D.1.2.b Grand Gulf

For the existing power plant, no intake structure is located in the river because of the use of Ranney Wells for makeup water for the cooling water system at the Grand Gulf Station. [Reference 2]

The existing plant makeup and service water is supplied by a series of radial collector wells located in the floodplain parallel to the Mississippi River. The collector wells have been constructed by sinking cylindrical concrete caissons into the alluvial aquifer, sealing the bottom with a concrete plug, and projecting perforated pipes horizontally into the aquifer. [Reference 2]

Each collector is equipped with two vertical turbine type pumps, each with a nominal pump capacity of 5000 gpm. Pump motors and related equipment are housed at the top of the caisson, 20 to 30 feet above natural floodplain grade. The operating floor for the pumps is at 96 feet which is above the 100-year flood elevation of 91.4 feet. Pumps at each radial collector well are provided with a recirculation line which discharges to the river bank via a 20-inch diameter pipeline. [Reference 2]

D.1.2.c Fitzpatrick

D.1.2.d Pilgrim

D.1.3 Flooding

River Bend and Grand Gulf have similar rainfall, floodplain and river proximity characteristics. However, River Bend rests at a slightly lower elevation relative to the Mississippi River than does Grand Gulf . This gives Grand Gulf a slightly lower (2-5%) anticipated cost associated with flooding design and construction considerations than River Bend. The Fitzpatrick site is considered roughly equivalent to the River Bend site regarding flood concerns. However, because of the position of the site adjacent to the Cape Cod Bay, it is probable that more extensive design and construction costs would be incurred for flood protection that for the RBS, GGNS or JAF sites.

D.1.3.a River Bend

The current site is on two levels: an alluvial floodplain along the east bank of the Mississippi River at an elevation of about 35 ft mean sea level (msl), and an upper terrace with an average elevation of over 100 ft msl. The station buildings are located on the upper terrace. Original ground grade was about el 110 ft msl. Finished ground grade for the existing power plant is about el 95 ft msl for the reactor and turbine plant, and is about el 105 ft msl for the cooling towers. The site is drained by Grants Bayou on the east and Alligator Bayou on the west. [Reference 1]

The River Bend Station site is located adjacent to the Mississippi River at about River Mile 262. The river at St. Francisville (River Mile 266.0) has a contributing drainage area of about 1,129,400 sq mi. [Reference 1]

The Army Corps of Engineers has made extensive studies of Mississippi River flood hydrology and has determined a project design flood (PDF). The PDF is based upon floods predicted by the U.S. Weather Bureau as the "maximum possible" and by the Mississippi River Commission as the "maximum probable". The PDF constitutes the basis for a determination of the probable maximum flood (PMF) at the site. The coincident occurrences of severe winds or upstream dam failures have been considered. It is demonstrated that the River Bend Station with grade at about 95 ft msl is well above flooding from the Mississippi River. [Reference 1]

D.1.3.b Grand Gulf

The site for Grand Gulf Nuclear Station is on the east bank of the Mississippi River in the vicinity of river mile 406, approximately 25 mi south of Vicksburg, Mississippi, and 6 mi northwest of Port Gibson, Mississippi. It is bounded on the west by the Mississippi River and on the east by loessial bluffs (forming part of the hilly region which extends from Vicksburg to Baton Rouge, Louisiana. The Mississippi River floodplain adjacent to the site is relatively low and flat with elevations ranging from 55 to 75 feet (above msl). [Reference 2]

The current power plant site is in the loessial uplands with a plant yard grade elevation of 132.5 feet. This elevation is well above the water levels in the Mississippi River.

D.1.3.c Fitzpatrick

The probable maximum setup of Lake Ontario at the JAF site was determined to be 4.1 ft above mean lake water level based on a two dimensional time dependent mathematical model. According to the storm study for the R. E. Ginna Plant (Docket No. 50-244-5), the maximum probable rainfall on Lake Ontario as a whole is 0.35 ft. The maximum flood level in the screenwell was, therefore, obtained by adding the maximum probable short term rise in lake level, 4.1 ft, and maximum probable rainfall on the lake, 0.35 ft, to the maximum controlled water level of el. 248.0 ft, resulting in a screenwell flood level of el. 252.5 ft. [Reference 3]

D.1.3.d Pilgrim

All surface drainage in the station site area is into Cape Cod Bay. The 40 ft msl ground surface contour closes within the property boundary and is open only to the bay. Thus, any flow along the ground surface will trend to the ocean. This contour crosses Rocky Hill Road, a public road. The 24 ft msl contour closes seaward of this road. Station grade is 20 ft msl. [Reference 4]

The maximum 24-hour rainfall is 6.88 inches. [Reference 4]

Prior to construction of the existing power plant, extensive studies of flooding based on tidal activity, hurricane and storm activity and seismic activity were conducted. During modeling of these events, '[t]he Reactor Building was at no time subjected to flooding. It was concluded that no Reactor Building flooding would occur even at the maximum estimated stillwater level based on ESSA Report 7-97 for hurricanes." [Reference 4] However, because of the position of the site adjacent to the Cape Cod Bay, it is probable that more extensive design and construction costs would be incurred for flood protection that for the RBS, GGNS or JAF sites.

D.1.4 Vibratory Ground Motion

Though River Bend and Grand Gulf are essentially in the same geologic region, the maximum peak horizontal acceleration assumed for the Safe Shutdown Earthquake for the existing power plant at Grand Gulf is 0.15g, while River Bend only assumes 0.10g. **Thus, by a slight margin (5%), River Bend's design and construction costs associated with vibratory ground motion are anticipated to be less than those of Grand Gulf.** The existing power plants at the James A Fitzpatrick and Pilgrim sites have a DBE assumption of 0.15g horizontal ground motion and are expected to require no special design or construction costs related to vibratory ground motion.

D.1.4.a River Bend

The River Bend Station site is located in an area of infrequent and low seismicity, typified by shallow focus earthquakes. Twenty-eight earthquakes of epicentral MM Intensity III-IV or greater have occurred within 200 mi (322 km) of the site. Of these, only four have occurred within 100 mi (161 km) of the site since 1811. The maximum historical earthquake in the Gulf Coast Basin tectonic province, for design purposes, is considered to be the Donaldsonville earthquake of epicentral MM Intensity VI. The Mississippi embayment tectonic province, in which the large New Madrid earthquakes occurred, is a distinct region from the site based on differences in structure and geologic history. This province extends southward to the South Arkansas and Pickens-Gilbertown fault systems along the Ouachita tectonic belt. Significant faulting associated with the New Madrid fault zone, which is located approximately 360 mi (579 km) north of the site, trends southwest to about 31 mi (50 km) northwest of Memphis, Tennessee. The southern extent of this fault zone is regarded to be a point near Memphis, which is 310 mi (499 km) north of the site. The Donaldsonville and New Madrid earthquakes are considered to be the only earthquakes important to the site and were felt at the site with MM Intensity IV and IV-V, respectively. No surface faulting was found within a 5 mi radius of the site. Consequently, **a safe shutdown earthquake (SSE) is selected at 0.10 g** at the foundation grade based on the seismicity of both the Mississippi embayment and the Gulf Coast Basin tectonic provinces. [Reference 1]

D.1.4.b Grand Gulf

The Gulf Cost Basin tectonic province, in which the site is located, is characterized by infrequent earthquakes of low epicentral intensities (Modified Mercalli Intensity VI or less), with an attendant low seismic-risk level. [Reference 2]

The peak horizontal acceleration at the site due to the maximum potential earthquake event does not exceed 0.1g. The design basis of the existing power plant conservatively assumed a value of 0.15g.

D.1.4.c Fitzpatrick

The NMP-JAF site consists of partially wooded land which was used almost exclusively for residential and recreational purposes prior to the construction of the Nine Mile Point Nuclear Station. For many miles west, east and south of the site, the country is characterized by rolling terrain rising gently up from the lake. The underlying rock structure is among the most structurally stable in the United States. [Reference 3]

The JAF site is located in a region which can be considered seismically inactive. Earthquake activity within 50 miles of the site has been infrequent and minor and no earthquake damage has resulted. Most of the reported earthquakes in the region are associated with well defined structural zones. [Reference 3]

Studies performed for the existing power plant concluded that "significant earthquake ground motion is not expected at the site during the design life of the plant. This historical record indicated that the Seismic Class I structures of the plant could be designed for an Operating Basis Earthquake of .05g horizontal ground acceleration, and a Design Basis Earthquake of .10g horizontal ground acceleration as all structures are founded on or within competent bedrock." However, to be conservative, the Operating Basis Earthquake was assumed to have a horizontal ground acceleration of .08g, and the Design Basis Earth-quake is assumed to have a horizontal ground acceleration of 0.15g. [Reference 3]

D.1.4.d Pilgrim

There are no known active faults within the region. The most recent known activity is associated with the emplacement of the White Mountain igneous intrusives which are approximately 170 to 190 million years old. [Reference 4]

Some studies of the area "indicate that the structure should be designed to withstand an earthquake of intensity V or VI which might occur near the site." [Reference 4]

An independent evaluation of the seismicity of the area concluded "that the site is not in an active seismic area, and that the critical structures should be designed for an earthquake of intensity V and that a Safe Shutdown Earthquake of intensity VII should be used." [Reference 4]

An additional review of the data "concluded that Class I structures should be designed for a ground acceleration of 0.08 g with 0.15 g used for safe shutdown." [Reference 4]

The Safe Shutdown Earthquake is generally considered to be a recurrence of the largest earthquake in the region at the closest epicentral distance which is consistent with the geologic structure. The Cape Ann series of earthquakes appear to be the most severe earthquakes which need be considered for plant design. The occurrence of an earthquake as large as the maximum Cape Ann sequency (intensity VIII, estimated magnitude 6), with its epicenter at the closest approach of faulting associated with the Boston and Narragansett Basins (17 mi west of the site) is the most critical situation for the site. Horizontal ground acceleration at estimated foundation depths (within the compact glacial deposits) due to the above earthquake would be about 0.15 g. [Reference 4]

D.1.5 Soil Stability

D.1.5.a River Bend

The River Bend Station site in West Feliciana Parish is located 3 mi southeast of St. Francisville, Louisiana, and approximately 24 mi northwest of Baton Rouge. The site lies within the Southern Hills section of the Gulf Coastal Plain physiographic province approximately 85 mi from the Gulf of Mexico. The plant area is situated on the uplands adjacent to the Mississippi Alluvial Valley. [Reference 1]

The geologic history and stratigraphy of the site region indicate that the Gulf Coast geosyncline consists of a wedge-shaped mass of sediments which thicken gulfward and were deposited in seas that encroached upon the continental margin. The sedimentary beds dip gulfward and exceed a thickness of 50,000 ft along the geosynclinal axis. The site is underlain by approximately 27,000 ft of predominantly unindurated sand, clay, gravel, and marl of Mesozoic and Cenozoic age, unconformably overlying Paleozoic rocks. The site is situated within the Gulf Coast Basin tectonic province. The site is located in a relatively domeless area between the Interior Salt Basin and the Coastal Salt Basin. South of the site, the sedimentary beds are interrupted by numerous east-west trending growth and slump faults, which become less steep with depth and become bedding plane slips. These faults are activated by compaction and subsidence of the sediments and are not derived from basement tectonic structures. Some movement may be continuing on several of these growth faults. The northernmost surface fault identified in the nearsite area is the Zachery Fault located approximately 8.0 mi southeast of the plant. A westward projection of this fault would pass about 5.5 mi south of the plant. [Reference 1]

Conditions for a landslide do not exist in the site area; the relief in the site area is very subdued, the slopes at the valley wall are only about 75 ft high rising from the backswamp area of approximately el +35 ft msl, and even these slopes have become less steep from prolonged erosion. Furthermore, these slopes are more than a mile from the plant area. [Reference 1]

No faults have been identified within the sedimentary sequence within 5 mi of the site to a depth of about 13,500 ft. Furthermore, there are no shears, joints, fractures, or folds in the sediments immediately beneath or in the area surrounding the plant area. [Reference 1]

For the existing power plant, the loess, Port Hickey top-stratum clays, the sand and clayey sands, and the variable upper portion of the Citronelle buried channel deposits were excavated to approximately the elevation of +20 ft msl to remove them from the site beneath the foundations of the Seismic Category I structures. These soils contain some fine sand and clayey sand layers below the founding grades with relatively low standard penetration test (SPT) blow counts and it was judged that the necessary assurance could not be provided that they could withstand the assumed SSE without liquefaction. Therefore, it was concluded that the subsurface materials above el +20 ft msl beneath all Seismic Category I structures should be replaced. The Seismic Category I structures are founded on compacted, well-graded granular fill placed over dense Citronelle buried channel sands and gravelly sand and the underlying hard Pascagoula clays. These foundation soils which were left in place are considered to be competent to support the Seismic Category I structures. The materials that were removed and the extension of these same strata beneath the other structures of the power plant present no problems because of their mineralogy. Furthermore, the net foundation loads are small and no significant settlements are expected based on the founding grades proposed. [Reference 1]

Thus, a new power plant at the site would require similar excavation of soils to reach foundation material preferable for Seismic qualification.

D.1.5.b Grand Gulf

The Catahoula Formation, which is the bearing system for all major structures of the existing power plant, consists of hard to very hard, gray to gray-green, silty to sandy clay and clayey silt, with some locally indurated or cemented clay, sand and silt seams. [Reference 2]

Results of laboratory testing indicated that Catahoula Formation is strong and competent for the foundation of plant structures. [Reference 2]

D.1.5.c Fitzpatrick

The NMP-JAF site consists of partially wooded land which was used almost exclusively for residential and recreational purposes prior to the construction of the Nine Mile Point Nuclear Station. For many miles west, east and south of the site, the country is characterized by rolling terrain rising gently up from the lake. The underlying rock structure is among the most structurally stable in the United States. [Reference 3]

The surface material consists of a very shallow thickness of ablation till underlain by a shallow thickness of basal till. The tills consist of mixtures of silts, sands, gravels, cobbles and some clay material. Total thickness of the till layer varies from about 0 to as much as 10 or 12 ft. The area is poorly drained because of its very low relief and there are a number of small swampy areas in the shallow depressions left in the till surface. The till layer lies directly on top of the Oswego sandstone. This is a hard, thin to medium bedded fine grained sandstone with laminations and lenticular beds of dark grey shale. The shale content increases with depth, and at approximately 130 ft below surface, the Oswego sandstones grade into the underlying Lorraine group, which is predominantly shale with some sand-stone members. The sandstones are a hard, competent material, well suited to the foundations of the plant. The Oswego sandstone is moderately jointed, the joints being the most common in the upper 5 to 10 ft. Below that depth, the joints are much more widely spaced and are tight. Master joint sets strike north 70 to 80 deg east, with a secondary set striking north 40 to 50 deg east. Joints basically are moderately to widely spaced. The shale members are well cemented, durable shales which show no slaking when exposed to the weather over a period of several years. They also are sound, competent foundation materials for the plant. [Reference 3]

The rock is well suited to the foundations of a nuclear power plant. The minor geologic features which were found during construction and also after construction have no effect on the design or safety of the plant. [Reference 3]

D.1.5.d Pilgrim

The surface soils consist primarily of sands with varying amounts of silts, clays, and some gravel and boulders. In general, the surface permeability in the area is moderately high. The vegetation cover consists mainly of relatively small deciduous trees and some conifers. Low brush is found throughout the site. [Reference 4]

The site is located on the shoreline of Cape Cod Bay near Rocky Point in Plymouth, Massachusetts. The site is within the deeply eroded Appalachian Mountain System and since Precambrian time, the region has had several episodes of folding, faulting, and igneous intrusion with associated metamorphism of pre-existing rocks. Glaciation and the Atlantic Ocean's rise to its present level have also modified the region's topography. There which characterize the geology of eastern Massachusetts. The site is located in a depression from 14 to 32 ft above mean sea level (msl) on the northeast side of a glacial ridge. Bedrock at the site is about 64 ft below msl and is topped by glacial and recent deposits. An upper discontinuous, erratic zone of sandy silts, and Boulders are also scattered throughout the overburdened soils. No known faults at or near the site were revealed. Cape Cod Bay is a circular embayment of the Atlantic Ocean and slopes gently to the north. The sea floor is broken in a few isolated below sea bottom, and is topped by sandy, gravelly, glacial deposits, clays, organic silts, and sand. [Reference 4]

D.1.6 Brownfield Site

D.1.6.a River Bend

D.1.6.b Grand Gulf

D.1.6.c Fitzpatrick

D.1.6.d Pilgrim

Appendix 2

D.2 TRANSPORTATION & TRANMISSION CRITERIA EVALUATION

D.2.1 Railroad Access

With the exception of the Pilgrim site, each of the sites has a railway spur onto facility property providing access to commercial railway access. For the purposes of this evaluation the sites with railway spurs and commercial rail access are considered equivalent with regard to design and construction costs associated with rail transport. Pilgrim will be ranked lowest in this category given the absence of an active railway access.

D.2.1.a River Bend

GSU purchased, from the Illinois Central Gulf Railroad, 1.2 mi of railroad south of the connection to River Bend Station's plant access railroad. From this junction northward past GSU's property boundary, the Illinois Central Gulf Railroad has abandoned the track which traverses the site in a northwest-southeast direction. [Reference 1]

Three rail lines pass through the site 5-mi radius. The Illinois Central Gulf Railroad, which has a branch line serving Crown Vantage and River Bend Station, the Missouri Pacific Railroad and the Kansas City Southern-Louisiana and Arkansas Railroad. [Reference 1]

D.2.1.b Grand Gulf

No railroad freight or passenger service is available in the immediate site area. The nearest track passes within 2.75 miles east-southeast of the site; however, it is unused.

There are no railroads or navigable waterways traversing the exclusion area of the existing power plant. [Reference 2]

D.2.1.c Fitzpatrick

A spur of the Penn Central Railroad provides rail service to the plant. Since the site is located on a navigable portion of Lake Ontario, the plant can be reached by barges for construction and supply purposes. [Reference 3]

D.2.1.d Pilgrim

No direct railway access to the Pilgrim site is document in existing facility design basis information. [Reference 4]

D.2.2 Highway Access

All four sites have hard-paved roads onto the facility location from local public roadways. At the current level of evaluation, differentiation between the sites is difficult to establish. In more detailed evaluation, issues such as state permitting, roadway weight constraints and traffic studies may be appropriate.

D.2.2.a River Bend

US Highway 61 is the nearest major north-south route, and is a minimum of approximately 1 mi from the reactor. State Highway 965, a paved, two-lane secondary road, traverses north and south into the center of the property and passes within 3,100 ft of the reactor. At the road-railroad intersection 3,250 ft west of the reactor, this highway becomes Police Jury Road and continues south and then east and north, connecting with US Highway 61 east of the plant. An unimproved parish road (River Road) parallels the river bank at the extreme west edge of GSU property. This road is approximately 1.8 mi from the reactor at its nearest point. Two new roads have been constructed as part of the plant. River Access Road runs from River Road near the intake and barge slip facilities (embayment) to Police Jury Road. This road serves as a construction-haul road and embayment access road, and is open to the public for use when necessary during periods of flooding to alleviate any traffic problems along the levee road. North Access Road connects US Highway 61 and State Highway 965. This road serves as the principal station access and is open to the public. It passes within 1/3 mi of the reactors. [Reference 1]

D.2.2.b Grand Gulf

The site area is accessible by both river and road. US Highway 61 and State Highway 18 connect Port Gibson (5 miles southeast of the site) with Natchez, Jackson and Vicksburg. Ferry boat service from Bruinsburg (11 miles southwest of the site) connects the county with St. Joseph in Tensas Parish, Louisiana. [Reference 2]

D.2.2.c Fitzpatrick

A private hard-surfaced east-west road bisects the site connecting the Oswego County Highway Route No. 29, which extends to the City of Oswego to the west and which on the east connects with U.S. Highway 104, three and three-fourths miles south of the site. A spur of the Penn Central Railroad provides rail service to the plant. Since the site is located on a navigable portion of Lake Ontario, the plant can be reached by barges for construction and supply purposes. [Reference 3]

D.2.2.d Pilgrim

Direct access to the site is available by road and sea. Normal land access is by a two lane paved road which was built across the site to Route 3A, leading to either Plymouth or nearby Route 3. Alternate access from the site to Plymouth and Route 3 via Route 3A is provided by Rocky Hill Road. [Reference 4]

D.2.3 Barge Access

All the sites being evaluated have barge access at the existing facility and access to commercial waterways for transport.

D.2.3.a River Bend

The Mississippi River passes near the plant and is a major route for waterborne commerce. The shipping channel is approximately 2 mi (3.2 km) from the plant. The nearest major river facility to River Bend Station is the port of Baton Rouge, located approximately 32 river miles downstream. A total of 60 barges can be held in the loading and unloading areas. River Bend Station has a barge slip used for deliveries during construction. [Reference 1]

D.2.3.b Grand Gulf

The site area is accessible by both river and road. Ferry boat service from Bruinsburg (11 miles southwest of the site) connects the county with St. Joseph in Tensas Parish, Louisiana. [Reference 2]

The nearest river port facility is located at Vicksburg, Mississippi, 25 miles from the site. [Reference 2]

A construction heavy-haul road, about 6800 feet long, connects the barge landing on the Mississippi River to the access road. [Reference 2]

D.2.3.c Fitzpatrick

Since the site is located on a navigable portion of Lake Ontario, the plant can be reached by barges for construction and supply purposes. [Reference 3]

D.2.3.d Pilgrim

Direct access to the site is available by road and sea. [Reference 4]

D.2.4 Transmission

D.2.4.1 Construction

An analysis was performed to determine the transmission injection capability, and associated system upgrade costs to achieve a 2000 MW incremental injection at the existing Entergy nuclear sites (only 1000 MW was used at both Pilgrim and Fitzpatrick). The analysis was performed using the latest summer 2004 Entergy PTI load flow case found on Entergy's OASIS website http://oasis.maininc.org/OASIS/EES in conjunction with PTI's MUST software, version 4.01. The maximum injection determined is the maximum amount of new generation that can be injected into the system at the specified location without causing an overload on any line or transformer for any single contingency (single line out). Due to the high-level nature of this study and its scope, identified limitations with less than a 12% impact were screened out as not being significant. Upgrade cost estimates were calculated using scaled drawings to estimate the line distances and using the following formulas and capital costs:

- 230kV lines = $300,000 per mile
- 345 & 500kV lines = $500,000 per mile
- 500kV auto-transformers = $1million base + $1million per every additional 100 MVA (rating)

In addition, given the long timeline for the ESP process and the nature of this injection study, all upgrade costs should be considered order of magnitude estimates only. Changes in the market and system upgrades not accounted for in this study could have a significant impact on the upgrades needed, and the subsequent cost, for the possible expansions at River Bend and Grand Gulf. The costs for the actual interconnect from the plant to the switchyard was assumed to be negligent compared to the system upgrade costs.

Site	MW Injection	Estimated System Upgrade Costs (millions)
Fitzpatrick	1000	$27.5
Grand Gulf	2000	$115.0
Pilgrim	1000	$7.5
River Bend	2000	$193.5

D.2.4.1.a River Bend

A 69-kV transmission line traverses the site along an abandoned railroad right-of-way that parallels the edge of the Mississippi River floodplain. A 230-kV transmission line aligned in an east-west direction is located south of the property. [Reference 1]

River Bend's has the lowest relative ranking, which is due to the high system upgrade cost estimate. The high cost estimate resulted from a large number of transmission line overloads that would result from an incremental 2000 MW injection at River Bend. These system overloads would require remedy by the new project.

D.2.4.1.b Grand Gulf

Grand Gulf's relative ranking is also low due to the high system upgrade cost estimate. The high cost estimate resulted from a large number of transmission line overloads resulting from an incremental 2000 MW injection at Grand Gulf. These system overloads would require remedy by the new project.

D.2.4.1.c Fitzpatrick

Fitzpatrick's relative ranking is due to a moderate system upgrade cost estimate for injection of 1000 MW. The analysis indicated that only one transmission line would be impacted; however, it is a fairly long line, resulting in the total upgrade cost estimate to reach a 1000 MW injection at Fitzpatrick.

D.2.4.1.d Pilgrim

Pilgrim is the best ranked site for transmission construction due to having the lowest system upgrade cost estimate for a 1000 MW injection.

D.2.4.2 Losses

D.2.4.2.a River Bend

River Bend is nearer to the load center of New Orleans than Grand Gulf, resulting in its higher relative ranking.

D.2.4.2.b Grand Gulf

Grand Gulf had the second lowest relative ranking for transmission losses due to being further from the New Orleans load center than River Bend.

D.2.4.2.c Fitzpatrick

Fitzpatrick is the lowest ranked site due to its poor location in western New York, which is west of a known major transmission constraint in mid-central New York. This known transmission constraint results in high transmission congestion losses at peak times between Fitzpatrick and the load centers of Albany and New York City.

D.2.4.2.d Pilgrim

Pilgrim is the closest to its load center of Boston, resulting in the highest relative ranking for transmission losses.

D.2.4.3 Competitive Access

D.2.4.1.a River Bend

River Bend is inside Entergy, which is still developing its regional transmission market area with no clear timeline for RTO formation. The relative ranking is similar to Grand Gulf's, and no real competitive advantage has been identified.

D.2.4.1.b Grand Gulf

Grand Gulf is inside Entergy, which is still developing its regional transmission market area with no clear timeline for RTO formation. The relative ranking is similar to River Bend's, and no real competitive advantage has been identified.

D.2.4.1.c Fitzpatrick

Fitzpatrick ranked highest for competitive transmission access. It is located in the deregulated NYISO market area, which has developed into a mature, efficient market with financial mechanisms to address transmission constraints.

D.2.4.1.d Pilgrim

Pilgrim ranked second highest for competitive transmission access. It is located in the deregulated ISO New England, which has also developed into a mature, efficient market. It is not as advanced as the NYISO yet; however, they are presently developing a financial mechanism for handling transmission constraint issues. Should PJM, ISO-New England, and NYISO merge, Pilgrim would become similar to Fitzpatrick.

Appendix 3

D.3 LAND USE & SITE PREPARATION CRITERIA EVALUATION

D.3.1 Topography

All four sites are located in topographically acceptable areas. The Pilgrim site does have more topographic asymmetries than the other sites. These asymmetries may cause higher design and construction costs in the development of a new plant at the site.

D.3.1.a River Bend

The topography in the area is essentially flat, with some small rolling hills. The greatest elevation within 5 mi of the site is 220 ft msl, which is 125 ft higher than plant grade. [Reference 1]

D.3.1.b Grand Gulf

The plant is located in Claiborne County, Mississippi. The plant site is on the east bank of the Mississippi River, approximately 25 miles south of Vicksburg and 37 miles north-northeast of Natchez. The Grand Gulf Military Park borders a portion of the north side of the property, and the community of Grand Gulf is approximately 1-1/2 miles to the north. The town of Port Gibson is about 6 miles southeast of the plant site. Two lakes, Gin Lake and Hamilton Lake, are located in the western portion of the property. These lakes were once the channel of the Mississippi River and range from about 5 to 7 feet deep. The site and its environs consist primarily of woodlands and farms and are about equally divided between two physiographic regions. The western half of the plant site property is in the alluvial plain of the Mississippi River; the eastern half is in the Loess or Bluff Hills. The elevation of the plant site property varies between 60 and 80 feet above mean sea level in the alluvial plain region whereas the Loess Hills portion varies from 80 to more than 200 feet above mean sea level (msl). [Reference 2]

D.3.1.c Fitzpatrick

The James A. FitzPatrick Nuclear Power Plant is located on the eastern portion of the Nine Mile Point promontory approximately 3000 ft due east of the Niagara Mohawk Power Corporation Nine Mile Point Nuclear Station, which is on the western portion of the site.* The NMP-JAF site is on Lake Ontario in Oswego County, approximately seven miles northeast of the City of Oswego. The plant is located at coordinates North 4,819,545.012 m, East 386,968.945 m, on the Universal Transverse Mercator System. [Reference 3]

The NMP-JAF site consists of partially wooded land which was used almost exclusively for residential and recreational purposes prior to the construction of the Nine Mile Point Nuclear Station. For many miles west, east and south of the site, the country is characterized by rolling terrain rising gently up from the lake. The underlying rock structure is among the most structurally stable in the United States. [Reference 3]

The site is generally level with very minor irregularities in surface. [Reference 3]

D.3.1.d Pilgrim

The site is located on the northeast side of the Pine Hills. The Pine Hills consist of a north-south trending ridge approximately 4 mi long which rises to an elevation of 395 ft mean sea level (msl).The ridge is the major drainage divide in the area. [Reference 4]

D.3.2 Land Rights

Each of the sites evaluated currently has adequate acreage for development. All of the sites evaluated have appropriate land use rights for such development as well. A more detailed evaluation should consider the permitting and siting requirements imposed on each site and evaluate the legal costs associated with such processes.

D.3.2.a River Bend

D.3.2.b Grand Gulf

D.3.2.c Fitzpatrick

D.3.2.d Pilgrim

The site is located on the western shore of Cape Cod Bay in the Town of Plymouth, Plymouth County,

Massachusetts and contains approximately 517 acres. [Reference 4]
Since the site is located along the coast, approximately 60 percent of the area within a 50 mile radius is open water. The area within 2 miles of the site is sparsely developed with the exception of the seasonal residences along Priscilla Beach and White Horse Beach. A triangular tract of land located within Entergy Nuclear's property is owned by a private party. Entergy Nuclear has made no arrangements with the current owner regarding future use or occupancy of the property. The Technical Specifications referenced define that the reactor is located approximately 1,800 feet from the nearest property boundary and no part of the present property shall be sold or leased by Entergy Nuclear which would reduce the minimum distance to less than 1,800 feet without prior NRC approval. The triangular tract of land is beyond this distance. [Reference 4] This condition may place constraints on a new plant siting.

D.3.3 Labor Rates

GGNS	JAF	PNPS	RBS	
0.00%	na	24.34%	6.82%	**Entry Level Mid-Scale Professional**
31638.79	na	39340.44	33796.79	
0.00%	26.33%	26.96%	23.14%	**Entry Level Engineer; Mid-Scale Professional**
39809.87	50290.38	50544.44	49023.46	
0.80%	15.66%	26.04%	0.00%	**Mid-Scale Engineer; Senior Non-Engineer Professional**
52660.56	60420.41	65847.51	52241.68	
3.88%	0.00%	19.32%	2.00%	**Senior Engineer; First Line Non-Engineer Management**
70107.62	67488.91	80526.87	68840.15	
4.24%	1.61%	11.34%	0.00%	**First Line Engineer Management; Second Line Non-Engineer Management**
88480.71	86246.92	94507.66	84884.43	
0.00%	23.36%	29.07%	9.11%	**Technician, Administrative Assistant, Electrician, Carpenter, Mechanic, Operator**
45139.43	55683.47	58262.45	49252.88	

As noted in the table above, based on current power plant pay scales, the general relative ranking of craft/non-professional labor costs at the sites is as follows (from lowest to highest cost): **(1) Grand Gulf, (2) River Bend, (3) Fitzpatrick, and (4) Pilgrim**. Note that the difference between GGNS and RBS is less than 10% and the difference between JAF and PNPS is less than 6%, effectively forming two pay groups with the difference between these groups being more than 14%.

For professional pay averaged across responsibility levels, the four sites again fall into two groups. GGNS and RBS are essentially the same with only a 2.15% difference. JAF and PNPS are essentially the same with less than 1% difference. The difference between groups is approximately 15%. The ranking for professional labor rates would be (again from lowest to highest cost): **(1) Grand Gulf, (2) River Bend, (3) Fitzpatrick, and (4) Pilgrim**.