Note: Changes made to the Executive Summary for the Draft SEIS are indicated by a vertical bar in the left margin

EXECUTIVE SUMMARY
of
FINAL SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

for

BROWNS FERRY NUCLEAR PLANT OPERATING LICENSE RENEWAL

ATHENS, ALABAMA

TENNESSEE VALLEY AUTHORITY

March 2002

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S.1 PURPOSE AND NEED FOR THE PROPOSED ACTION

Project Overview

The Tennessee Valley Authority (TVA) proposes to extend operation of Units1, 2, and 3, at its Browns Ferry Nuclear Plant (BFN) located in Limestone County, Alabama. This would require obtaining a renewal of the units' operating licenses from the Nuclear Regulatory Commission (NRC). Renewal of the current operating licenses would permit operation for an additional 20 years past the current (original) 40-year operating license terms which expire in 2013, 2014, and 2016, for Units 1, 2, and 3, respectively.

This Supplemental Environmental Impact Statement (SEIS) is being prepared to provide the public and TVA decision-makers an assessment of the environmental impacts of extending unit operation. Table S.1 shows key milestones for the preparation of the SEIS. License renewal by itself involves existing BFN facilities, and does not involve any new construction or modifications beyond normal maintenance and minor refurbishment. However, there are other proposed projects not directly related to license renewal. One of these projects is the recovery of Unit 1, which has been in a non-operational status for 15 years. Other projects include the addition of a dry cask storage facility for spent nuclear fuel and a few new office buildings. In the interest of completeness, these actions are being included in this SEIS.

Table S.1 Planned Milestones for BFN Operating Licenses Renewal SEIS

Action	Date
Issue Notice of Intent (65 FR 47817)	February 15, 2001
Public Scoping Meeting	March 6, 2001
Close of public scoping period	March 23, 2001
Issue Notice of Availability of Draft SEIS	December 14, 2001
Public meeting on Draft SEIS	January 17, 2002
Close of public comment period	January 30, 2002
Release Final SEIS	March 2002
Issue Record of Decision	May 2002

Tiering from Energy Vision 2020

Tiering from TVA's *Energy Vision 2020* Programmatic EIS incorporates it by reference in this SEIS and allows concise and efficient consideration of the strategies and programmatic issues related to both maintenance of existing generation capacity in TVA's power system and the addition of new geneation capacity. *Energy Vision 2020* evaluated an array of power supply resources, both supply-side and demand-side. These alternatives were ranked using several criteria, including environmental performance. Favorable alternatives were formulated into strategies that would effectively meet baseload energy and peak capacity needs of TVA's customers under a range of future conditions ("futures"). A number of these strategies were then combined to create TVA's short- and long-range energy resource plans, or collectively, TVA's integrated resource plan (IRP).

Nuclear generation is expected to play a vital role in helping TVA meet energy supply demands through the *Energy Vision 2020* study period (1996 through 2020). The *Energy Vision 2020* Resource Integration Strategy Matrices identified five nuclear units, located at three sites, as existing generating assets on the TVA system - BFN Units 2 and 3, Sequoyah Nuclear Plant Units 1 and 2, and Watts Bar Nuclear Plant Unit 1. These five units were determined to contribute 5,517 megawatts, or 20% of the TVA system total projected capacity of 27,995 MW in 2005.

The operating nuclear units at BFN will reach the end of their current operating licenses during the *Energy Vision 2020* study period. *Energy Vision 2020* anticipated that Units 2 and 3 would be excellent candidates for license extensions. *Energy Vision 2020* also discussed both the short-term and the long-term options for BFN Unit 1. For the short-term, the IRP concluded that it was not viable to restart BFN Unit 1 because there were more optimal power supply strategies identified to meet load growth, particularly in consideration of cost, impact on short-term rates, impact on debt, and competitiveness. In order to preserve long-term flexibility, the decision was made to maintain BFN Unit 1 as an inoperative deferred nuclear asset. This enabled TVA to maintain lower rates and debt for the short-term and consider other alternatives for BFN Unit 1 as conditions changed.

Energy Vision 2020 noted that deferring the decision to recover BFN Unit 1 for several years would allow additional time to acquire information regarding nuclear unit performance and economics, TVA's need for power, and the possible role of nuclear power in minimizing total environmental impacts. Moreover, *Energy Vision 2020* concluded that under certain conditions, recovery of BFN Unit 1 could emerge as a low-cost supply option. This set of conditions, referred to as a "high performance" future, consisted of the high load forecast, low cost to complete the nuclear units, low operations and maintenance costs, and a high nuclear capacity factor. Since issuing *Energy Vision 2020*, a number of developments covering each of these areas has made it timely to consider further the recovery of BFN Unit 1 to meet TVA's long-term resource requirements.

- Acknowledging the recent rapid growth in baseload demand, TVA currently estimates that approximately 2,000 GWh annually by 2005, and 5,000 - 15,000 additional GWh annually by 2010 will be needed.
- Adjusted to 2002 dollars, *Energy Vision 2020* projected median Unit 1 completion at nearly $3.1 billion; current estimates are $1.64 billion.
- *Energy Vision 2020* projected annual additions and improvements costs to be $41 million; actual 2001 costs for BFN were $24 million.
- BFN operations and maintenance costs for 2001 are 17% below the low forecast in the IRP.
- The IRP low forecast estimate for nuclear fuel costs in 2001 was 47.9 cents per million BTU; the actual cost for BFN in 2001 is 47.1 cents per million BTU.
- The IRP assumed 67% annual average capacity factor. BFN has averaged 92% capacity factor over the past five years.

BFN's performance and costs have improved to the point that it is now considered by the Institute of Nuclear Power Operations (INPO) to be among the top performing nuclear plants in the country. It is a Top Quartile performer on Total Production Costs and the INPO Performance Index, and a Top Decile performer on Non-Fuel Production Costs, Net Capacity Factor, and Outage Duration. In conclusion, there is now strong support for the lowered estimates of capital cost, improved operating performance, and high demand case that would bolster recovery of BFN Unit 1 as a low cost power supply option.

Tiering from the BFN Environmental Statement

An earlier Environmental Statement prepared by TVA evaluated the effects on the environment of construction and operation of BFN. The Atomic Energy Commission (AEC), a former regulatory agency of the federal government which has since been superseded by the NRC, participated in the preparation of this statement as a cooperating agency. The AEC concluded on August 28, 1972, that the statement was adequate to support the proposed license to operate the plant.

This SEIS will reference (and not repeat) analyses contained in the original 1972 Environmental Statement wherever possible. However, since methodologies may have changed or additional information may have been obtained over the years, each subject area will be reevaluated in the light of current knowledge and practices. Additional topics are addressed as appropriate.

Unit Uprates

Independent of the matters considered in this SEIS, TVA has reviewed the environmental impacts of, and has approved, an Extended Power Uprate (EPU) project which will increase the maximum operating power level of Units 2 and 3 to 120% of their originally licensed thermal power levels. If Unit 1 is returned to service, it is currently contemplated that it would also be uprated to 120% of its originally licensed thermal power level.

Purpose of the Proposed Action

The purpose of the proposed action (extending unit operation and possibly recovering Unit 1) is to continue to make maximum use of existing power production facilities and the BFN site into the foreseeable future.

Need for the Proposed Action

TVA, in its annual report to the Southeastern Electric Reliability Council, projected continued growth in demand of total net energy (baseload) at about the median level through 2010. These data reflect an average energy growth rate of approximately 2% per year. Acknowledging the recent rapid growth in baseload demand, TVA currently estimates it will need approximately 2,000 GWh annually by 2005, and 5,000 - 15,000 additional GWh annually by 2010.

Continued energy generation from BFN is a major component of TVA's generating assets, representing 8% of generating capacity and about 13% of annual energy generation in FY2000. Because of its low operating costs, BFN will continue to be a key generating asset even if some TVA customers were to elect other suppliers for some of their requirements under electricity deregulation.

S.2 ALTERNATIVES INCLUDING THE PROPOSED ACTION

Description of the No Action Alternative

The No Action Alternative would result from a decision to not extend operation of the BFN units beyond the expiration dates of the current operating licenses. Since it currently appears economically infeasible to recover Unit 1 without license renewal, such a decision would effectively terminate any further consideration of restarting that unit at this time. Operation of Units 2 and 3 would cease upon expiration of their operating licenses in 2014 and 2016, respectively, and the plant would then be required to choose a decommissioning option.

This No Action Alternative would not help meet the public's demands for more energy from the TVA power system. If TVA took no action at all to meet growing demands, TVA's ability to continue to supply low-cost, reliable power to its customers would be impaired. The impacts of higher priced and undependable electricity supplies would be manifested in customer hardship. Higher costs of electricity could trigger industrial slowdowns or work force outages, and could potentially negatively affect the economic stability of the region served by TVA. Not meeting demand and using less reliable sources of generation could have environmental and health consequences as well if the result was disruption of electric service to the public. For example, if the electricity needed to power air conditioners in the homes of elderly people is disrupted, heat related injuries and death could result.

Consequently, it would be unreasonable for TVA to take no action at all to meet growing demands. Rather, in this context, No Action means that TVA would turn to some other means of responding to energy demands on its power system. These means have been assessed in TVA's Energy Vision 2020 EIS and are identified in the short- and long-term energy resource plan that the TVA Board approved after the completion of that EIS process.

Proposed Action Alternatives

Two Action Alternatives are consistent with the stated project objectives and the updated cost comparison of alternatives previously evaluated in *Energy Vision 2020*.

Alternative 1 is to continue to operate Units 2 and 3 for an additional 20-year period beyond the expiration dates of the current licenses. No major equipment changes are projected to be needed for continuing operation as-is, but some planned upgrades and additions would involve facilities modifications. Due to the planned EPU of Units 2 and 3, a sixth mechanical draft cooling tower would be erected.

Alternative 2 is to add refurbishment and restart of Unit 1 to Alternative 1 (i.e., extended operation of all three BFN units at the EPU level of 120% of the originally licensed power level). Restart of Unit 1 could occur as early as 2007 if a favorable decision is made and recovery efforts are initiated. Unit 1 recovery would necessitate construction of a new administration building to make space available to incoming (temporary) workers and to move (permanent) office workers away from radiation sources associated with operating Unit 1 with hydrogen water chemistry.

Restarting Unit 1 would also require additional cooling tower capacity beyond that envisioned for Alternative 1. The additional cooling tower capacity required could be obtained by a

combination of constructing new towers, refurbishing the old original cooling towers, or even dismantling and replacing one or more of the old original cooling towers with an updated and more efficient design. The following sub-alternatives to provide the required additional cooling tower capacity are evaluated in this SEIS:

Alternative 2A is to add two new linear mechanical draft cooling towers to the six that would be functional for operation of Units 2 and 3 at EPU, making a total of eight very similar cooling towers. Making room for these new towers would require removal of most of a large hill which was created by excavation of drainage canals associated with construction of the original six cooling towers.

Alternative 2B is similar to Alternative 2A except that the two new cooling towers would be some type other than the current linear mechanical draft cooling towers, such as round mechanical draft or modified hyperbolic design.

Alternative 2C is to demolish the remaining four original cooling towers (two burned down, and only one has been replaced) and to construct 5 new large linear mechanical draft cooling towers, all in roughly the same location as the original six towers. The size of the existing (relatively new) tower 3 would also be increased. This alternative would not require removal of a significant portion of the spoils hill adjacent to the cooling towers, but could involve lowering the height of the hill by several feet to decrease wind resistance.

Alternative 2D is to add a sixth mechanical draft cooling tower in the currently vacant position (4) where a tower that was destroyed by an accidental fire in 1986 has never been replaced. This addition of a sixth cooling tower differs from that proposed for Alternative 1 (see above) in that the tower would be somewhat larger than the recently replaced 16-cell linear mechanical draft cooling tower 3.

For purposes of this SEIS, each of the cooling tower configurations for Alternatives 1, 2A, 2B, and 2C described above represents the maximum expected change in terms of the number and size of required additional towers. Alternative 2D represents the minimum change in the number and size of required additional towers. BFN cooling water discharges comply with a National Pollutant Discharge Elimination System (NPDES) permit issued by the Alabama Department of Environmental Management (ADEM). The impact analyses presented in this SEIS assume that thermal limits in the current BFN discharge permit are unchanged and continue to be met for all alternatives via increased cooling tower capacity or de-rating power operation during periods of extreme weather, or both, with these alternative configurations.

Table S.2 provides a summary and comparison of the proposed action alternatives.

Table S.2 Summary of Proposed Action Alternatives					
Attribute/ Feature	**Alternative 1**	**Alternative 2A**	**Alternative 2B**	**Alternative 2C**	**Alternative 2D**
Units	Units 2 & 3 only	Units 1, 2, & 3	Units 1, 2, & 3	Units 1, 2, & 3	Units 1, 2, & 3
Power Level	EPU[1]	EPU[1]	EPU[1]	EPU[1]	EPU[1]
Cooling Towers	6 Linear Mechanical Draft[2]	8 Linear Mechanical Draft[3]	6 Linear Mechanical Draft + 2 Round[4]	6 Large Linear Mechanical Draft[5]	6 Large Linear Mechanical Draft[6]
Spoils Berm Reconfiguration	Minor (possibly lower hill height)	Major (relocate most of berm)	Major (relocate most of berm)	Minor (possibly lower hill height)	None to minor (possibly lower hill height)
New Buildings	Modifications / Fabrication	Mod/Fab plus Administration	Mod/Fab plus Administration	Mod/Fab plus Administration	Mod/Fab plus Administration
New Spent Fuel Storage	Dry Cask Storage Facility	Larger Dry Cask Storage Facility	Larger Dry Cask Storage Facility	Larger Dry Cask Storage Facility	Larger Dry Cask Storage Facility

[1]Extended Power Uprate = 120% of originally licensed power level.
[2]Four of the original six Ecodyne towers plus the existing Balcke-Durr tower in position 3 plus one new large or expandable tower in currently vacant position 4.
[3]Same as Alternative 1 plus two new large towers located in space currently occupied by spoils berm.
[4]Same as Alternative 1 plus two new round mechanical draft or modified hyperbolic ("hybrid") towers.
[5]Replace the four existing original Ecodyne towers plus one new large tower in position 4 plus expand the existing Balcke-Durr tower in position 3.
[6] Four of the original six Ecodyne towers plus the existing Balcke-Durr tower in position 3 plus one new larger tower in currently vacant position 4.

Associated Cooling Water Intake Flow Rates

Subsequent to issuance of the original three-unit National Pollutant Discharge Elimination System (NPDES) permit in 1984, BFN has made various equipment upgrades and calibration improvements which collectively have resulted in per-unit increases in reported once-through cooling water flow rates of 21.5%. Note that more than half of the increase in reported values is due to improved measurement accuracy; the actual increase in flow is approximately ten percent. For continued operation of Units 2 and 3 the flow rates of once-through cooling water withdrawn from the reservoir remain within the levels evaluated as part of previous studies conducted during three-unit operation at BFN; therefore, impingement of adult fish and entrainment of fish eggs and larvae are expected to remain within levels previously evaluated for Alternative 1. With the return of Unit 1, the total site once-through cooling water flow rate would increase by about ten percent. This increased CCW intake volume would potentially result in increased impingement of adult fish and entrainment of fish eggs and larvae, but it is not expected to result in significant impacts to fish populations of Wheeler Reservoir. TVA will confirm the expected levels of impingement and entrainment by monitoring under current two unit operation and following return of Unit 1 to service. TVA's Vital Signs monitoring program will also continue to assess aquatic ecological communities in Wheeler Reservoir. Although not expected, if based on these monitoring studies it is determined that increased impingement and entrainment are resulting in unacceptable environmental impacts, TVA would assess the technologies, operational measures,

and restoration measures that could be undertaken to remedy this and institute appropriate measures in consultation with appropriate federal and Alabama agencies.

The Preferred Alternative

TVA has made no decision with respect to the BFN license renewal Alternatives identified in this SEIS, or the other proposed actions. However, based on TVA's analyses of the environmental aspects and costs to date, Alternative 2D is TVA's currently preferred alternative. This is because there are positive environmental effects to be gained, no significant or unacceptable environmental impacts have been identified to date, and the initial cost analysis indicates that recovering Unit 1 for extended operation would be financially feasible and beneficial.

Spent Fuel Storage Options

BFN has been producing power and, consequently, spent nuclear fuel for almost three decades. Considering the Department of Energy (DOE) delay in developing the capability and capacity for receiving utility spent fuel, and assuming current operating conditions, the BFN Unit 3 spent fuel storage pool is projected to lose full core off-load capability in January 2006; therefore, additional spent fuel storage capacity will be required to be developed before then. Thus, spent fuel storage expansion is required significantly before license extension or feasible implementation dates for three-unit operation. However, the addition of spent fuel storage capacity is included in this SEIS as a connected action because license extension and Unit 1 restart would both impact the ultimate size of the facility.

To accommodate the spent fuel storage expansion, TVA has evaluated various options to extend the effective life of the existing BFN spent fuel pools as well as alternatives for separate new spent fuel storage capacity. The preferred spent fuel storage option is construction of a dry cask storage facility, similar to those in use at 18 other U.S. nuclear power plants and planned at others.

S.3 AFFECTED ENVIRONMENT

Air Resources

The local climate and meteorology of the Browns Ferry Nuclear Plant site is characterized in the TVA Environmental Statement, Volume 2, Section 3.3. Variations during the period for which the relicensing is applicable are not expected to be significantly different. Current National Ambient Air Quality Standards for particulate matter, sulfur dioxide, carbon monoxide, ozone, nitrogen dioxide, and lead are essentially unchanged from those considered in the TVA Environmental Statement of the early 1970s, with one exception. The standard for hydrocarbons in effect at that time was later rescinded and a standard for ozone was implemented. There are currently no nonattainment areas for any of these pollutants in the area of the site. Air quality conditions are expected to remain about the same as now with the exception of possible regulatory constraints that may develop in association with future implementation of new EPA standards on ozone and particulates. However, those standards are the subject of legal challenges.

Sources of non-radiological air pollutants at BFN include the mechanical draft cooling towers, the auxiliary steam generators, the emergency diesel generators, and miscellaneous other small sources such as fuel storage facilities. BFN operates as a minor source under air quality permits approved by the Alabama Department of Environmental Management (ADEM).

Geologic Setting

The BFN area is underlain by flat-lying, underformed limestone of Mississippian age. This immediate region has experienced little structural deformation over the past several hundred million years of geologic time. The BFN is located in an area far removed from any centers of significant seismic activity in historic time. The seismic hazard at BFN is low in comparison to most other areas of the United States.

Solid Wastes Management and Past Practices

Solid wastes generated in conjunction with operation of BFN are managed in accordance with applicable NRC and State and Federal environmental regulations, and disposed in approved and licensed disposal facilities.

General plant trash collected as part of routine plant operations is managed through a TVA-wide contract with a licensed disposal company. Waste material is collected in dumpsters and transported to a State-licensed regional landfill. Generation rates for this type of material are currently approximately 50 tons per month. BFN has an active recycling program that segregates and recycles scrap metal, cardboard, paper, batteries, and aluminum cans at approved State and local recycling facilities.

BFN operates a State-permitted Construction/Demolition landfill within the confines of the BFN site. This landfill is permitted to accept non-hazardous, non-radioactive solid wastes including scrap lumber, bricks, sandblast grit, crushed metal drums, glass, wiring, non-asbestos insulation, roofing materials, building siding, scrap metal, concrete with reinforcing steel, and similar

construction and demolition wastes. The generation rate for this type of material over the past two years is approximately 0.04 tons per day.

BFN generation rates for low level radioactive waste materials are approximately 30-40 cubic meters per month. Spent resins are packaged, de-watered and stored on-site in concrete storage modules, or shipped for burial in a licensed disposal facility. Dry active waste is collected within the plant, and transported to a waste processor for volume reduction and subsequent shipment to a licensed disposal facility. Irradiated non-fuel plant components are stored on-site or processsed for shipment to a licensed disposal facility.

Hazardous Wastes Management and Past Practices

As do many large industrial facilities, BFN generates a variety of wastes that are classified as hazardous. These wastes include paint-related materials, spent solvents used for cleaning and degreasing, spent batteries, fluorescent light tubes, etc. TVA operates a Hazardous Waste Storage Facility (HWSF) in Muscle Shoals, Alabama, that holds a permit for temporary storage of hazardous wastes. The HWSF serves as a central collection point for TVA-generated hazardous wastes, and maintains contracts with waste treatment and disposal facilities. All hazardous waste generated at BFN is shipped to the HWSF for consolidation, storage, and disposal through approved and licensed facilities. BFN recycles paint solvents (primarily methyl ethyl ketone) using an on-site still. Hazardous waste generation rates for BFN average approximately 4,700 pounds per calendar year over the last five years.

Spent Fuel Management

An Independent Spent Fuel Storage Installation (ISFSI) is proposed for operation beginning in 2005. Expansion of an ISFSI can be accomplished incrementally. This technology can accommodate life-of-plant requirements regardless of DOE repository schedules or plant operation changes.

After implementation of spent fuel dry storage, sufficient capacity would be maintained in the spent fuel pools to accommodate refueling outages. Older spent fuel would be transferred to dual-purpose storage modules (i.e., metal cask or canister with overpack) for storage at the BFN ISFSI. The fuel transfer from pool storage racks to dry storage modules would be performed in the spent fuel pool. The dry storage system would be licensed for both on-site storage and off-site transportation; consequently, these dry storage systems would not require fuel to be repackaged for transport to a DOE repository.

Depending on the dry storage system design chosen for BFN, each storage module could contain up to 68 spent fuel assemblies; five of these modules would typically be loaded before each refueling outage. After loading, the dual-purpose storage module would be drained, dried, decontaminated, sealed, and then transferred by crane to the truck bay for transport to the ISFSI. Storage modules containing spent fuel would be temporarily stored at the ISFSI until a DOE spent fuel repository is available.

Surface Water Resources

BFN is located on Wheeler Reservoir at Tennessee River Mile (TRM) 294. The reservoir was created in 1936 and has an area of 67,070 acres and a volume of 1,050,000 acre-feet at the normal summer pool elevation of 556 feet (msl). Most of Wheeler Reservoir is classified by ADEM for public water supply, swimming and other whole body water-contact sports, and fish and wild life. However, the area of the reservoir immediately upstream and downstream of BFN is not classified for public water supply. Water quality is generally good and suitable for most designated uses. The one exception is a 10-mile reach of the river between Wheeler Dam and the Elk River which is on the state 303 (d) list as partially supporting its designated uses due to pH and temperature/thermal modifications caused by industrial sources and flow regulation and modification. Water temperature patterns in Wheeler Reservoir are constantly changing in response to varying meteorological and flow conditions. Natural water temperatures in the reservoir vary from around 35^{o}F in January to near 90^{o}F in July. Temperature patterns upstream of BFN are fully mixed during the fall, winter, and spring with weak thermal stratification from June through September.

There are 8 potable water intakes on Wheeler Reservoir withdrawing a total of approximately 124 million gallons per day (MGD) for municipal and industrial use. Wastewater discharges include 10 municipal plants discharging over 30 MGD and 17 industrial plants discharging over 2,466 MGD. Consumptive and off stream water uses do not currently result in significant use conflicts due to the large volume of reservoir water available, the high river flow rate, and the return of most of the water withdrawn. Regulatory control of withdrawal rates and NPDES permit limits for return water quality also mitigate potential conflicts. However, potential trade-offs can occur with instream water uses (e.g., instream use conflicts among aquatic life, waste assimilation, navigation, power generation, flood control, and lake levels).

Groundwater Resources

Shallow groundwater at BFN occurs within unconsolidated terrace deposits and residual soils, and along a relatively thin but highly weathered horizon at the top of bedrock. At depth, groundwater occurs exclusively in fractures and solution features of the Tuscumbia limestone and Fort Payne chert. The Tuscumbia limestone and Fort Payne chert are collectively described as the Tuscumbia-Fort Payne aquifer system which is a source of water for both wells and springs in the region. Groundwater within this aquifer system is a calcium bicarbonate type and can generally be used without extensive treatment. There is no groundwater use by BFN and site dewatering wells have been inactive since the 1980s.

Groundwater levels at the site are generally highest during the months of January through March. During September and October, water levels are usually at minimum. The Tennessee River and plant surface water features exert some control on local groundwater elevations and hydraulic gradients. The direction of groundwater movement is generally W-SW toward the Tennessee River. Within overburden soils at the site, groundwater movement is predominantly downward. Local areas of lateral flow likely occur near some streams, topographic lows, and where extensive root systems exist. Groundwater flow in the Tuscumbia limestone occurs solely in fractured and weathered zones. The orientation of fractures and solution features within the Tuscumbia is coincident with a structurally controlled joint system.

Floodplains and Flood Risk

BFN is located on the right bank of Wheeler Reservoir at TRM 294.0 in Limestone County, Alabama. The proposed project area could possibly be flooded from the Tennessee River, a small stream to the northwest of the plant site and the site drainage system. The site drainage system is broken into three areas: 1) the switchyard, 2) the main plant area, and 3) the cooling tower system. The area impacted by the construction of any of the alternatives extends from about TRM 293.0 to TRM 294.0.

The 100-year floodplain for the Tennessee River would be the area below elevation 557.3. The TVA Flood Risk Profile (FRP) elevation on the Tennessee River would also be elevation 557.3. At this location, the FRP elevation is equal to the 500-year flood elevation. The Probable Maximum Flood (PMF) design level would be 572.5 feet. A maximum flood elevation of 574 at the plant site results from a combination of the PMF and wind wave runup on a vertical wall or 575 as a result of the PMF and wind wave runup on a 3:1 grassed slope.

For the small stream to the northwest of the site and the internal site drainage system, the 100- and 500-year, and PMF flood elevations have been assessed. The maximum possible discharge for this stream is 17,200 cfs. For the switchyard drainage channel, the PMF elevation at the holding pond at the downstream end of the channel would be 574.8 and the PMF elevation at the north corner of the switchyard would be 577.8. The PMF elevation between the office and service buildings would be 566.6. In the vicinity of the radioactive waste, reactor, and diesel generator buildings, PMF elevations for all modes of plant operation would not exceed elevation 564.0. In the cooling tower system of channels there is sufficient capacity to pass the PMF and condenser water.

Flooding conditions during the term of the renewed license (up to year 2036) are expected to remain similar to current conditions. For the Tennessee River, all dams in the TVA system are assumed to be maintained and remain operational for the entire licensing period. For the small stream northwest of the plant site, significant urbanization within the 1.35 square mile drainage area is not expected to occur during the next 35 years. If complete urbanization were to occur, the 100- and 500-year flood discharges could increase as much as 2.5 times the natural discharge. The switchyard drainage channel area, the main plant area, and the cooling tower system area all have some existing impervious area within their drainage basins. Additional impervious area would increase the 100- and 500-year flood discharges by some amount, but should not cause flooding greater than that produced by the PMF event.

Terrestrial Ecology

Little native vegetation remains in the project areas because of the activities associated with the construction and operation of the existing nuclear facilities. The proposed location for the new cooling towers (i.e., the spoils hill that would be removed for Alternatives 2A and 2B) consists of old field vegetation with scattered tree species including black locust, various oaks, loblolly pine, and eastern red cedar. *Sericea lespedeza* and broomsedge are among the dominant herbs. The proposed locations for soil deposition consist of two hayfields and a fallow cotton field now vegetated by a dense thicket of blackberry, Japanese honeysuckle and *Sericea lespedeza*, with scattered saplings of black locust and eastern red cedar. No uncommon communities or otherwise sensitive vegetation occurs on or immediately adjacent to the project areas.

Aquatic Ecology

Extensive TVA sampling of the fish community in the vicinity of BFN and elsewhere in Wheeler Reservoir in recent years has collected a total of 60 species (excluding hybrids); any species known from elsewhere in the reservoir could occur in the vicinity of BFN.

Reservoir Fish Assemblage Index (RFAI) ratings are based primarily on fish community structure and function. Also considered in the rating is the percentage of the sample represented by omnivores and insectivores, overall number of fish collected, and the occurrence of fish with anomalies such as diseases, lesions, parasites, deformities, etc. Compared to other run-of-the-river reservoirs, the fish assemblage at the Wheeler mid-reservoir transition station (TRM 295.9) rated poor in 1992 and 1999, fair in 1990, 1991, 1995, and 1997, and good in 1993 and 1994. In the fall of 2000, additional (i.e., not on the regular RFAI monitoring schedule) electrofishing and gill net samples were taken at the transition station (TRM 295.9) and a newly-established sampling station for future BFN monitoring at TRM 292.5. A total of 30 fish species (excluding hybrids) was collected; the fish assemblage rated good at TRM 292.5 and fair at TRM 295.9.

Benthic (i.e., bottom-dwelling) animals common in the vicinity of BFN include Asiatic and fingernail clams, burrowing mayflies, aquatic worms, and midges in the silt-laden overbank areas. Cobble and bedrock areas found primarily in the river channel support Asiatic clams, bryozoa, sponges, caddisflies, snails, and some leeches. Thirty-eight native freshwater mussel species have been documented in Wheeler Reservoir through 1991; more recent surveys have identified up to fourteen species in the area of BFN. Introduced aquatic species known from Wheeler Reservoir include the Asiatic clam, zebra mussel, and grass carp.

Threatened and Endangered Species

No federally listed and four Alabama state-listed plant species are known from Limestone County, Alabama, in which BFN occurs. None of these state-listed plants are known to occur within five miles of the project area. In addition, field inspections of the project area reveal that suitable habitats for these or other rare plant species are not present on lands to be affected by the proposed activities.

Four state-listed animal species (two of which are also federally listed) are known from Limestone County, but none of them are reported within five miles of BFN. Three of these species have no suitable habitat at BFN; there is a limited amount of habitat at BFN for the fourth species but its quality is considered marginal.

Five federally endangered aquatic species are known to occur in the vicinity of BFN. However, their preferred types of habitat do not exist at or downstream of BFN, and it is very unlikely that populations of these species exist in Wheeler Reservoir at or downstream of BFN.

Wetlands

Wetland resources in Alabama have suffered a marked decline as the result of channelization of major streams and the clearing of wetlands for agricultural and other purposes. The extensive

areas of bottomland forested wetlands that occurred in the major stream bottoms prior to channelization and land clearing are largely absent from the landscape.

Wetlands in the vicinity of BFN are a mix of habitat types, including palustrine forested wetlands, scrub-shrub wetlands, and emergent wetlands associated with the mainstem of the Tennessee River/Wheeler Reservoir.

Wetlands in the general project area were identified using United States Fish and Wildlife Service (USFWS) National Wetland Inventory (NWI) maps and topographic maps. A determination of areas subject to jurisdiction by the United States Army Corps of Engineers (USACE) under Section 404 of the Clean Water Act (CWA) on the site was made by TVA wetland biologists pursuant to the regulatory program administered by the USACE. Wetland field surveys indicate that while there are small areas of wetland within the boundaries of BFN, there are no wetlands in the immediate project area. This includes both the area proposed for construction of the new cooling towers, and the spoil disposal area.

Socioeconomic Conditions

Limestone County has experienced rapid growth over the last few decades, with population increasing faster than in the labor market area, the state, or the nation. The population of the county, according to the 2000 Census of Population, is 65,676, an increase of 21.3% since 1990, and 57.5% since 1970. This growth pattern is likely to continue for the next several years, with the population of the county reaching more than 80,000 by 2015, about the time the current BFN licenses expire.

Minority population in Limestone County and in the labor market area is a smaller share of the total than in the state or the nation.

Unemployment in Limestone County and in the labor market area was low in 2000, 3.3% in the county and 3.9% in the labor market area, below both the state and national averages. The number of jobs in the county has grown rapidly, more than doubling since 1970. This growth is expected to continue, reaching about 41,000 in the county by the time the current BFN licenses expire and close to 58,000 by the time a 20-year extension would expire. The county is more dependent on jobs in manufacturing, government, and farming than is the labor market area, the state, or the nation, and less dependent on trade and services employment.

Per capita income in Limestone County in 1999 was just below 75% of the national average, while in the labor market area it was almost 86% of the national average. Poverty levels in the county and the labor market area are below the state average. The county poverty level is about the same as the national average, but the labor market area level is slightly lower.

Transportation, including Electric Power Transmission

The site is located approximately 10 miles southwest of Athens in Northern Alabama in Limestone County and is located just south of U. S. Highway 72, which runs from South Pittsburg, Tennessee, west to Memphis, Tennessee. The primary traffic generator in the vicinity of the site is the nuclear plant. BFN currently averages a daily site population of approximately 1,200 persons. The population currently peaks at approximately 2,000 persons during outages,

which occur every 24 months for approximately 2 months (per unit). Current truck deliveries are minimal (less than 10 per week) and include hydrogen, oxygen, and nitrogen trucks, chemical trucks and occasional gasoline and diesel fuel deliveries during peak months. Rural residences located along the county roads that provide access to the site are also traffic generators in the area. TVA estimates approximately 1,600 vehicles per day on Shaw Road, Browns Ferry Road, and Nuclear Plant Road.

Although direct rail access does not serve BFN, a spur track and unloading area is located off the CSX mainline in Tanner, Alabama, approximately 8 miles east of BFN. TVA leased this small parcel of land from CSX and used it for offloading during original construction of the plant. This area is currently planned to be used for future off-site removal of dry cask spent fuel storage canisters. There is also a short railroad spur at the plant that runs into the turbine building for short transport into the plant. There are no plans to use it for Unit 1 refurbishment or regular plant operations.

BFN is located downstream from Guntersville Lock and upstream from Wheeler Lock at TRM 294. Traffic on the Tennessee River near BFN includes both commercial and recreational vessels. The locks and channels are more than adequate in handling river traffic. Both Guntersville Lock and Wheeler Lock are operating below their utilization capacity. BFN has a qualified barge facility near the northwest corner of the site. The facility is used several times per year and requires a temporary crane. Future upgrading is planned and a temporary crane will no longer be required. An upgraded barge facility could eventually be used to transport spent fuel canisters offsite for disposal in a national repository.

BFN is connected into the TVA system network by seven 500-kV lines. One line is to Madison substation, two to Trinity substation, one line each to the West Point, Maury, and Union substations, and one line to the Limestone 500-kV Substation. Any three lines excluding more than one Trinity line can transmit the entire station output into the TVA system network. Startup power is from the 500-kV system network, but auxiliary power is available through the two common service station transformers that are fed from two 161-kV lines supplying the 161-kV switchyard, one line each from the Athens and Trinity substations.

Soil and Land Uses

Limestone County is part of the Highland Rim section of the Interior Low Pleateaus physiographic province. It is comprised of three physiographic subdivisions: The Limestone Valleys, the Plateau, and the Alluvial Plains. The Limestone Valleys include the southeastern part of the county. The Alluvial Plains include the nearly level to undulating first bottoms and stream terraces along the Tennessee and Elk Rivers. BFN is located in the Limestone Valleys and Alluvial Plains. The soils which develop in these areas are inherently productive for growing crops. There are about 279,229 acres of soils in the county classified as prime farmland and/or statewide important farmland. These are soils which have the chemical and physical properties to economically sustain high yields of crop production. Most of the soil on the BFN site was disturbed when the plant was constructed and is no longer considered as prime farmland. The entire site is classified as urban built-up land.

BFN is located in an agricultural area, surrounded by cropland planted with cotton. About 66.8% of the total acreage in the county is used for agriculture, the highest in Alabama. Limestone County is ranked first in Alabama for the most cotton grown. Agriculture is, and will continue to

be, a major economic component in the county. The remainder of the acreage in the county is used for forest (23.9%), water (7%), and urban/built-up land (2%).

The current trend in population growth will promote a larger portion of the land area to become urbanized. Population trends show an increase by 17.7% from 1980 to 1990, another increase of 17% from 1990 to 1998, and predictions from the Equifax Decision Systems project another increase of 6.6% by 2005. These trends are attributable to the increased employment opportunity in the county as well as in nearby Huntsville and Decatur.

Visual Resources

BFN is located off of County Road 25 (Nuclear Plant Road) approximately twelve miles south of Athens, Alabama. The site is surrounded to the north and east by rural countryside. It includes open pasturelands, scattered farmsteads, few residents, and little industry within several miles. The terrain is gently rolling with open views to higher elevations to the north. Little traffic is seen along the roadway except at plant shift changes and during deliveries. The south and west side of the plant site abuts Wheeler Reservoir, which is a wide expanse of open river used for an array of recreational purposes.

There are no homes within foreground viewing distance to the north and east. However, there is a small residential development to the northwest, across Wheeler Reservoir southwest, and Mallard Creek public use area that has partial views of the plant site. The views from the homes northwest off of County Road 25 are of the existing mechanical draft cooling towers (approximately 60 feet in height), a portion of the 500-kV switchyard and the turbine and reactor building. A berm, graded during the initial construction of the plant site and containing approximately 3.3 million cubic yards of earth, lies adjacent to the hot and cool water channels and blocks views of the northern and eastern plant areas. The homes to the southwest and from the Mallard Creek area have views of the off gas stack, the cooling towers, and the turbine and reactor building. These views may be somewhat obscured in the early morning hours, particularly in the fall and winter, as heavy fogs rise from the warmer waters of the reservoir.

Recreation

Approximately 3.5 miles upstream of BFN is Round Island Recreation Area developed and operated by TVA. It features facilities for camping, swimming, picnicking and boat launching. The reservoir in the vicinity of the plant site is moderately utilized by recreational boaters and fishermen. Two managed areas occur within three miles of the BFN site, Swan Creek State Wildlife Management Area and Mallard-Fox Creek State Wildlife Management Area. These areas are owned by TVA and presently managed by the Alabama Department of Conservation.

Cultural Resources

TVA Cultural Resources staff considered the nature of the undertaking and determined that the project had the potential to affect historic properties should those be present in the area. The area of potential effects (APE) for archaeological resources was determined as the three areas designated as soil disposal or spoil pile locations. The APE for historic structures was determined as those areas from which the disposal locations would be visible.

A Phase I survey was conducted at the three disposal site/spoil pile locations. This survey identified two historic properties. The survey of Area 1 (see Figure ES-1) identified a prehistoric archaeological site with an Early to Middle Woodland occupation. This site is considered potentially eligible for listing in the National Register of Historic Places. Cox Cemetery was identified in Area 2. This cemetery was relocated during the initial construction of the BFN. No historic properties were identified in Area 3.

Environmental Noise

The addition and replacement of cooling towers have the potential to change the noise environment within about a mile of their location. Within this radius there has been a significant increase in residential development since the original construction of the plant. The sensitive noise receptors are in Paradise Shores adjacent to the cooling towers to the northwest and the Lakeview community across the river. Potential noise effects evaluated include hearing loss, speech interference, annoyance, and increased awareness of the intruding noise. During present operations, cooling tower noise is audible in the closest portions of Paradise Shores but not in Lakeview or other residential locations around the plant.

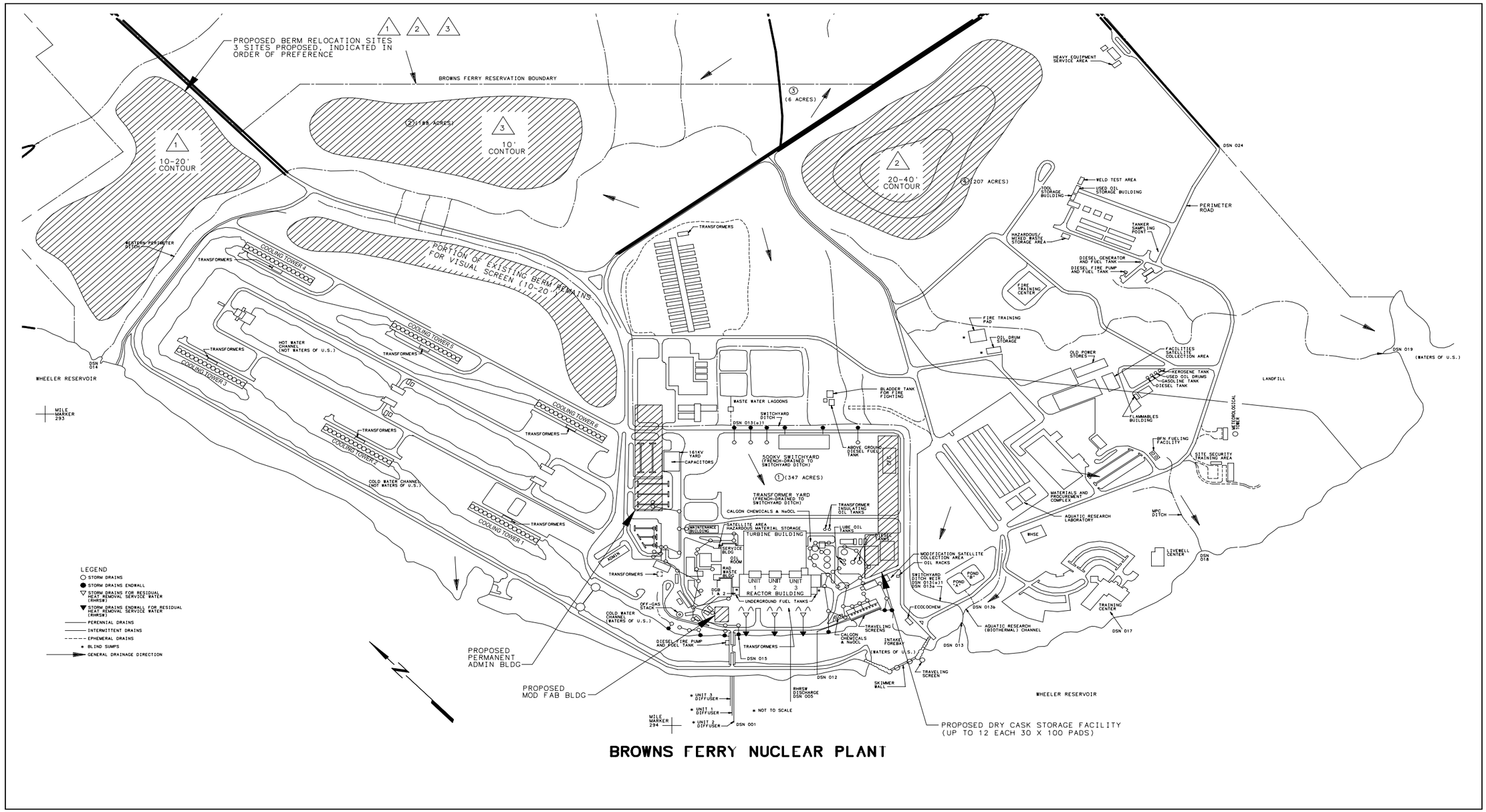
Public and Occupational Safety & Health (Non-Radiological)

The TVA nuclear work force has achieved recordable injury rates that are among the lowest in the utility industry. Operation and construction (i.e., refurbishment and restoration) activities are required to meet or exceed federal regulatory requirements for safety design and inspection, including OSHA regulations. These standards and requirements also apply to TVA contractors and vendors, which are monitored to ensure compliance.

The TVAN Safety and Health Manual contains requirements designed to assure that management administers a strong safety program. BFN has a Fire Protection Plan which is applicable to all activities which could affect the life or health of TVA employees or the public, the probability or severity of potential fires throughout the plant, or the ability to maintain safe plant shutdown, or limit radioactive release to the environment in case of fire. In accordance with state and federal regulations, BFN has developed a Spill Prevention, Control, and Countermeasure Plan that includes Hazardous Materials Response Team assignments and responsibilities, best management practices for controlling and managing oil and chemical storage, and contingency plans in the event of an accidental spill. TVA has also concluded that operation of BFN has not resulted, and is not likely to result, in adverse human health effects as a consequence of the presence of microorganisms associated with cooling towers and thermal discharges.

TVA's standard for siting new transmission lines has the effect of minimizing public exposures to electric and magnetic fields during their operation. TVA's design also ensures that the transmission lines exceed National Electric Safety Code requirements regarding shock hazards.

Figure ES-1
Location of Areas for Spoils Deposition



Radiological Impacts

At BFN, occupational radiation doses (to site workers) are consistent with current industry trends for this reactor type (BWR) and worker radiation exposures are controlled to be significantly less than regulatory limits. Similarly, controlled releases of radioactive emissions during normal operations result in radiation doses to the public that are small relative to doses from natural radioactivity. TVA has conducted a Radiological Environmental Monitoring Program (REMP) since 1973 to assess the impact of BFN operations on the surrounding environs and the general public. Data collected via the REMP demonstrate that the small amounts of radiological effluents released to the environment due to the operation of BFN have had no measurable impact on the environs surrounding BFN, and that estimated doses to the maximum exposed member of the public are typically only a small fraction of applicable limits.

BFN has a Radiological Emergency Plan (REP) which provides protective measures for TVA personnel and protects the health and safety of the public in the event of a radiological emergency resulting from an accident at the plant. This plan fulfills federal regulatory requirements and was developed in accordance with the NRC and Federal Emergency Management Agency (FEMA) guidance. Specific implementing procedures ensure that accidents are properly evaluated, rapid notifications are made, and assessment and protective actions are performed. In conjunction with the REP, State Radiological Emergency Plans have been developed to provide integrated response actions of Federal, State and local governments to any emergency caused by an incident at BFN. The REP is also designed to be implemented in a variety of non-radiological emergencies such as chemical spills, toxic gas releases, fires, plant operational problems, natural events, etc., which may pose a threat to the safe operation of the plant and have a potential impact offsite.

Postulated accidents for which the NRC has determined the probability is sufficient to warrant specific inclusion in design basis analyses are documented in the Updated Final Safety Analysis Report (UFSAR). BFN has also completed a systematic and comprehensive analysis of the potential accidents that can occur at the plant, referred to as a Probabilistic Safety Assessment (PSA), which incorporates both system reliability and human intervention. Extremely unlikely (and therefore not part of the design basis), but potentially more severe accidents are also considered via an analysis of Severe Accident Mitigation Alternatives (SAMA).

Decommissioning Impacts

TVA is required to complete decommissioning of the plant within a maximum of 60 years after permanent cessation of operations. To decommission a nuclear power plant, the radioactive material on the site must be reduced to levels that would permit termination of the NRC license; this involves removing the spent nuclear fuel, dismantling any systems or components containing activation products, and cleaning up or dismantling contaminated materials. All activated materials generally have to be removed from the facility and shipped to a waste processing, storage, or disposal facility. Contaminated materials may either be cleaned of contamination on-site, or the contaminated sections may be cut off and removed (leaving most of the component intact in the facility), or they may be removed and shipped to a waste processing, storage or disposal facility.

S.4 ENVIRONMENTAL CONSEQUENCES

Air Resources

For any of the Alternatives, potential and cumulative impacts on local climate and meteorology are expected to be less than the assessment results in the TVA Environmental Statement of the early 1970s. Conservative plume modeling and conservative operating assumptions that were used in the original EIS gave results that encompass (bound) the Alternative 2 options for increased cooling tower capacity because actual cooling tower operations have been and are expected to occur only in the warmer months, generally limited to summer. This is much less time than the 29% annual use assumed in the original EIS.

Based on operating experience, impacts on ambient air quality are all expected to be smaller than the magnitudes given in the original EIS, with the exception of carbon monoxide. Emissions and ambient concentrations for carbon monoxide were about two orders of magnitude too small compared to amounts reported during actual operations. However, the ambient air quality standard for this pollutant is still five orders of magnitude larger than this revised estimate, so the impact is considered negligible. The original EIS's assumption of maximum operation in the helper mode 22% of the time was applied to Alternative 2 with its increased cooling tower capacity options. (The 7% closed mode included in the EIS was not quantified because operation in this mode is now known to be impractical.) In this updated assessment, particulate emissions in the form of drift from the towers would be about 22 pounds/hr compared to an emissions standard for fine particulates of 45 pounds/hr. Total annual emissions would be about 21 tons/yr compared to the 100 tons/yr in the original EIS. Construction and modification impacts on air quality during refurbishment of Unit 1 also would be minor and transitory.

Geologic Setting

Construction of additional water cooling capacity under any of the alternatives considered should result in no significant impacts to the geologic resources and hazards. The changes to crustal loading caused by excavation and movement of materials and the construction of new structures should have negligible effects on the seismicity of the area. The local geology and character of local seismicity would not be impacted by continued operation of BFN.

Solid Wastes Management and Past Practices

Continued operation of BFN Units 2 and 3 through the license extension period should not result in generation of additional volumes of general plant trash which exceed the levels currently generated annually. If Unit 1 is restarted, the amount of general plant trash would be expected to increase in proportion to the increase in site population required for the recovery effort. In addition, there would be additional trash generated as a part of construction activities, but this amount would be significantly less than that generated by construction of a new facility. Once operational, the amount of trash generated would be similar to the other operating units, and the overall amount generated would increase slightly due to the small increase in permanent plant staff necessary to operate three units.

BFN would continue to maintain the license to operate the on-site construction/demolition (C/D) landfill through the duration of the extended BFN operating licenses. In the event Unit 1 is restarted, the on-site C/D landfill has the space and capacity to handle the small amount of additional wastes associated with construction activities. Should the on-site facility prove inadequate, there is sufficient alternative capacity in surrounding off-site C/D landfills.

Generation rates for low level radioactive waste would not be expected to exceed existing rates as a result of extension of the BFN licenses. Should Unit 1 be restarted, generation rates for low level radioactive wastes would be expected to increase during construction activities due to additional asbestos removal operations and the normal increases associated with nuclear construction activities. Once operational, the generation rates for this type of waste activity would increase in proportion to the additional operational activity associated with three unit operation. BFN has provisions in place to either store or ship for processing and disposal the volumes of material generated. Existing storage and disposal facilities have adequate capacity to handle the volumes of material expected to be generated during the extended life of BFN with either two unit or three unit operation.

Hazardous Wastes Management and Past Practices

Generation of hazardous waste would not be expected to increase for BFN as a result of license extension. Existing processes for managing these wastes within TVA would be expected to continue, and capacities for existing disposal and treatment facilities should be adequate to handle the relatively small volumes of material generated. Over the past 15 years, BFN has significantly reduced the generation of hazardous wastes through a combination of source reduction and product substitution. These ongoing waste reduction efforts would be expected to further reduce the number of waste streams and the volumes of waste generated at BFN.

Construction activities associated with Unit 1 restart would temporarily increase rates of hazardous waste generation due to the increased use of solvents and paint related materials necessary for refurbishment. The existing TVA process for management of this type of waste is adequate to handle the expected increase. Once operational, hazardous waste generated as a result of operation of Unit 1 would be within the normal year to year variation currently experienced.

Spent Fuel Management

Environmental consequences of additional spent fuel management resulting from license extension of either two or three BFN units would be minimal. The additional spent fuel which would accrue during the license extension period would be stored in the spent fuel pool or a dry storage system approved by NRC. Compared with license renewal of only Units 2 and 3, the addition of Unit 1 would simply increase the number of storage casks needed and the required size of the ISFSI. Subsequently, BFN spent fuel would be transferred to the DOE in accordance with the Nuclear Waste Policy Act of 1982 and subsequent amendments.

Surface Water Resources

Under Alternative 1, no significant construction impacts are expected. Best management practices and construction control measures would be employed to control surface runoff and contain potential pollutants. All waste materials will be handled and disposed in accordance with regulatory requirements. There would be no significant changes in current operational impacts. Regulatory requirements will control potential adverse impacts from plant discharges and operations. Thermal impacts from continued operation of Units 2 and 3 will remain within the levels evaluated during the original EIS. No additional thermal impacts to water temperature, reservoir stratification, sediment transport, scouring, dissolved oxygen concentrations, or eutrophication are expected.

Under Alternatives 2A, 2B, 2C, and 2D, potential construction and operational impacts are similar. Construction impacts are expected to be temporary and insignificant using best management practices (BMPs) and pollution control measures. The restart of Unit 1 would require upgrading the cooling tower system and increased flow rates from a maximum flow of approximately 2,312 MGD for Units 2 and 3 to approximately 3,468 MGD with three units operating. The discharge temperature of the cooling system water will be essentially the same for three-unit operation, due to the proportional increase in cooling water flow. However, the total amount of heat added to the river and the water temperatures at the edge of the mixing zone would increase with three units operating. Modeling analyses using historical data indicate that the maximum discharge temperature and the temperature rise between intake and discharge will remain within regulatory limits. Use of the cooling towers would increase, and on rare occasions when the cooling towers are unable to meet the thermal limits, the plant would be derated to remain in compliance. The implications of the thermal effects on reservoir water temperatures, dissolved oxygen concentrations, and eutrophication were also modeled. The results suggest that Alternatives 2A, 2B, 2C, and 2D should have insignificant effects on reservoir stratification, dissolved oxygen concentrations, eutrophication, sediment transport, and scouring.

Groundwater Resources

There are no adverse impacts to groundwater resources associated with Alternative 1. Activities potentially affecting groundwater resources would include foundation treatment, excavation, and grading associated with Alternative 2 facilities. Excavations which penetrate the water table may require temporary construction dewatering. Any groundwater drawdown impacts associated with plant construction dewatering would be temporary and of negligible magnitude due to the limited excavation depths, the relatively short duration of facility construction, and the distance of neighboring wells.

Excavation and grading associated with construction of the proposed facilities would result in permanent displacement of shallow soils above the water table (e.g., the proposed berm relocation sites). However, the long-term impact of these activities on groundwater resources would be negligible for all facility configurations given the limited depth and area of disturbance. Although permanent local impacts to groundwater levels and movement might be experienced from foundation treatment, the long-term impacts of these activities on groundwater resources would be negligible for the proposed cooling tower configurations given the limited area of disturbance. Potential contaminant releases (e.g., fuels, oils, and solvents) during construction activities would be averted by careful handling and proper disposal of potential contaminants

according to BMP guidelines. No adverse impacts to groundwater resources are anticipated from operation and maintenance of new facilities associated with Alternative 2 or the other alternatives.

Floodplains and Flood Risk

The floodplains and flood risk assessment involves ensuring that facilities would be sited to provide a reasonable level of protection from flooding. In doing this, the requirements of Executive Order (EO) 11988 (Floodplain Management) are taken into account. Due to the nature of this facility, it is necessary to evaluate the flood risk associated with the Probable Maximum Flood (PMF) elevations for all alternatives.

Under Alternative 1, all existing and proposed facilities are, or would be, located outside the limits of the 100- and 500-year floodplains. Therefore, the project would be consistent with EO 11988. All safety-related structures are protected against all flood conditions and would not be endangered by the PMF. The proposed dry cask storage facility and permanent administration building would be located on ground above the PMF elevation based on site topography dated 1989. The proposed Modifications Fabrication Building would be located on ground below the PMF elevation, but the site would be raised or the building would be floodproofed consistent with other facilities of this nature on the plant site. Based on site topography, the proposed mechanical draft cooling tower would be located above elevation 570.

During the license renewal period (up to year 2036), the 100- and 500-year flood, and PMF elevations for the Tennessee River would not be expected to change as stated in Section 3.8 of the SEIS. Although the 100- and 500-year flood flows for the small stream to the northwest of the plant site and the site drainage system could increase by as much as 2.5 times what they are now, these flows would not adversely impact existing or proposed development because they would be significantly lower than the PMF flows, and these channels can handle PMF flows without flooding the plant.

Anticipated flood impacts for Alternatives 2A, 2B, 2C, and 2D would be the same as those listed for Alternative 1, except for potential PMF flooding impacts to the new cooling tower(s). Equipment within the cooling towers that could be damaged by floodwaters would be located above or floodproofed to the PMF elevation, as required. The construction of these towers would involve the relocation of material to one of three potential spoil areas. These areas are located outside the limits of the 100-year floodplain which would be consistent with EO 11988.

Terrestrial Ecology

With respect to botanical aspects of Terrestrial Ecology, impacts are anticipated to be the same under all alternatives. No uncommon communities or otherwise significant vegetation types are known from the vicinity and impacts to this resource are anticipated to be insignificant.

Likewise, impacts to terrestrial animal communities would be similar under all alternatives. Due to previous levels of disturbance at the site during construction and operation of existing facilities, little suitable habitat of wildlife exists on site. No populations of rare or uncommon animals exist at the project site. Adoption of the proposed alternatives would not result in adverse impacts to uncommon animals or their habitats.

Aquatic Ecology

If Unit 1 is not returned to operation, but Units 2 and 3 are relicensed under Alternative 1, the total maximum two-unit intake volume, even with past plant modifications that increased Condenser Circulating (i.e., cooling) Water (CCW) flow, would be within the bounds of previously-assessed intake volumes at which fish impingement and entrainment of fish eggs and larvae were determined to not adversely impact Wheeler Reservoir fish populations. With the return of Unit 1 to operation under Alternative 2, the total CCW flow would increase by about ten percent. This increased CCW intake volume would potentially result in increased impingement of adult fish and entrainment of fish eggs and larvae, but is not expected to result in significant impacts to fish populations of Wheeler Reservoir.

TVA will confirm the expected levels of impingement and entrainment by monitoring under current 2-unit operation and following return of Unit 1 to service. TVA's Vital Signs monitoring program will also continue to assess aquatic ecological communities in Wheeler Reservoir. Although not expected, if based on these monitoring studies it is determined that increased impingement and entrainment are resulting in unacceptable environmental impacts, TVA would assess the technologies, operational meaures, and restoration measures that could be undertaken to remedy this, and institute appropriate measures in consultation with appropriate federal and Alabama agencies.

Thermal impacts to aquatic life would be insignificant under any of the proposed action alternatives because the maximum discharge temperature will remain within approved regulatory limits. With implementation of BMPs and other specialized measures as needed to prevent entry of pollutants into surface waters, impacts to aquatic life resulting from construction of new facilities would be insignificant.

Threatened and Endangered Species

For threatened and endangered plants, the impacts are anticipated to be the same under all 5 Action Alternatives. No rare (listed) plants are known from the vicinity and no impacts to this resource are anticipated. No threatened or endangered aquatic animals are presently known from the potentially affected area, and no impacts to this resource are anticipated. Four state-listed terrestrial animal species (two of which are also federally listed) are known from Limestone County, but none of them are reported within five miles of BFN. Adoption of any of the proposed alternatives would have no effect on threatened or endangered terrestrial animals or their habitats.

Wetlands

No wetlands occur on any portion of the sites proposed for construction and excavation or disposal of spoil materials. Therefore, there would be no impacts or effects upon wetlands by activities proposed under any of the alternatives.

Socioeconomic Conditions

Discontinuing Plant Operation (upon Expiration of Current Licenses)

Discontinuing operations would require that the plant begin the decommissioning process. There would be some loss of jobs as the plant went into the process, followed by further loss at the end of the decommissioning period. In addition to these direct losses of income and employment, there would be additional indirect income losses as a result of decreased spending associated with the direct job losses. However, the number of jobs lost would be roughly one percent of the labor force of Limestone County and only a small fraction of the labor force in the labor market area. Impacts to community services and housing and to local government revenues would be small. No disproportionate impacts to disadvantaged populations in the local area are expected.

Alternative 1

Under Alternative 1, there would be no significant change in operating employment levels, payroll, or other plant-related expenditures. There would be some construction activity associated with construction of the cooling tower (part of the previously reviewed EPU of BFN Units 2 and 3), modifications/fabrication building, and spent fuel dry cask storage facility, requiring a small number of workers (less than 100 at peak) for a brief period of time. However, impacts to employment and income would be small and temporary.

There would be no important impacts to community services and housing and to local government revenues. No disproportionate impacts to disadvantaged populations in the local area are expected.

Alternative 2

Under any of the variations of Alternative 2, construction activities would result in important impacts on population, employment, and income over a time span of about 5.5 years. The total number of workers involved in the construction phase would peak at about 3,000, although not all of these are likely to be located at the plant site. Operation of Unit 1 in addition to current operation of Units 2 and 3 would require an increase in employment of about 150 permanent workers. This would be a small addition to the local economy.

Construction would result in some short-term strain on community services, including police and emergency services. Schools and the housing market likely would experience short-term strains. These impacts, however, would be scattered throughout the labor market area, not just in Limestone County. The increase in permanent employment associated with operation of Unit 1 in addition to the Units 2 and 3 could have a temporary impact on the local housing market and housing prices. However, the operations impacts would be small. Local government revenues would increase as a result of increases in the in-lieu-of-tax payments by TVA. No disproportionate impacts to disadvantaged populations are expected.

Transportation

Alternative 1 will result in no impacts to the traffic generated by the plant because it would remain at the existing level. However, background traffic growth is expected to continue between

now and when the renewed licenses expire. Assuming 15% growth per decade, traffic on the county roads would increase to approximately 2,600 vehicles per day.

Additional traffic would be generated due to refurbishment of Unit 1, and there would be impacts to state and county roads in the vicinity of the site. The Action Alternatives 2A, 2B, 2C, and 2D will have additional traffic generated in the form of operation and construction workforce employee travel and construction and operational material deliveries. During the refurbishment period the workforce rises to peak levels of 3,055; assuming an average ridership of 1.6 persons per vehicle, and one trip in and out each day, about 3,820 vehicles will be added to the road network due to daily commuters during this peak construction period. The average daily traffic on Shaw Road, Nuclear Plant Road, and Browns Ferry Road would increase from the current 1,600 to about 2,900 vehicles per day, which represents a temporary (but not unacceptable) decrease in the level of service. This decrease in level of service from LOS C to LOS D would result in traffic flow conditions that could be tolerated for short periods of time. In this instance, such conditions could occur at shift changes twice during the day and last up to one hour. The county roads are in good condition for access and will be adequate to support the traffic requirements during both construction and operation; however, construction periods are temporary and peak forces only last for approximately six months. There will be some delay turning onto County Road 25 from the plant due to traffic congestion at shift changes and leaving multiple exits simultaneously. Over a long period of time, there is a natural progression to improve the quality of the local roadway network and it can be assumed that the roadway network would be improved in the normal course of events. U.S. Highways 31 and 72 would not be significantly affected.

TVA has completed a transmission study as recently as June 2000 for BFN which assessed the ability of the offsite power system to meet NRC requirements for electric power systems. This study included a 5-year look-ahead to the summer 2005 peak system load of 33,775 megawatts (MW), and assumed BFN Units 2 and 3 were generating at full power with a per-unit power uprate to 1,155 MW gross. The study examined both load flow and transient stability in response to a number of postulated system alignments, contingencies and design basis accident conditions. It was concluded that all the cases studied meet the BFN minimum voltage and design requirements.

TVA has analyzed the transmission line condition and loading in the vicinity of the BFN site, and has determined that restart of Unit 1 at EPU would require additional 500-kV circuit breakers to be installed in the existing 500 kV switchyard, and several 161-kV transmission lines are projected to become overloaded due to single contingency events. Line uprates (i.e., retensioning or increasing tower height or adding towers as necessary to maintain height clearances of conductors which warm and sag under higher power loading), reconductoring (i.e., increasing conductor size), the addition of a second 500-161kV transformer bank at the Madison 500kV substation, or other solutions would be required to correct these overloads. A Static Var Compensator and Capacitors would also be needed for regulating system voltage. These upgrades and equipment additions involve existing facilities with available spaces; any associated environmental impacts would be minimal. There would be no need to obtain new Right of Ways or construction of new transmission lines under any of the alternatives.

The alternatives considered in this SEIS have no impacts on railroads, river transport, or pipelines.

Soil and Land Uses

Activities associated with license renewal and operation of Units 2 and 3 at extended power uprate would have no impact on soils or land use on the plant site. Potential impacts to site soils and land use associated with refurbishing Unit 1 and license renewal for all 3 units, including construction of the additional cooling towers, dry cask storage facility, new administration building, and new modifications/fabrication building, would be insignificant. These construction activities would be located on previously disturbed soils and in built-up areas. Facilities for construction workers would be temporary and at completion of the project the land would revert to prior use.

Operational impacts of any of these activities on land use in the surrounding areas would be insignificant. Current trends in local land use are toward development of more land for residential and commercial use. This is a result of population growth averaging 17% per decade. Any growth associated with either of these proposed activities would be minimal compared to current trends. Existing power line easements are sufficient, no new transmission lines are proposed as part of this license renewal process.

Visual Resources

Impacts under the No Action Alternative would be insignificant. The plant site would remain in its current state and would remain visually unchanged. Under Alternative 1, minor visual impacts would include additional plumes seen by area residents and motorists along adjacent roadways. Alternative 2A will introduce two new cooling towers in the landscape, similar to those that exist now. Alternative 2B, however, will provide two cooling towers that will contrast vertically to the existing towers. Alternative 2C, demolishing the four existing Ecodyne cooling towers, constructing 5 new linear mechanical draft cooling towers and increasing the size of the existing Balcke-Durr cooling tower by 25%, would add to the number of linear elements seen across the plant site. Alternative 2D is the construction of a sixth mechanical draft cooling tower in the currently vacant position (4) where a tower that was destroyed by an accidental fire in 1986, has never been replaced. This addition of a sixth cooling tower differs from that proposed for Alternative 1 (see above) in that the tower would be somewhat larger than the recently replaced 16-cell linear mechanical draft cooling tower 3. The visual impact of Alternative 2D would essentially be the same as that for Alternative 1 since a single mechanical cooling tower of a similar design (but slightly shorter length) would otherwise have been built in the same location for the EPU project. Alternatives 1 and 2D would have the least visual impact for both plant workers, visitors, and motorists along County Road 25 under the Action Alternatives.

Recreation

There are no recreation facilities impacted by either alternative. Under either of the alternatives, there would be insignificant affects on recreation resources, facilities and activities.

Cultural Resources

TVA determined that the project had the potential to affect historic properties within the three areas designated as soil disposal or spoil pile locations. The Area of Potential Effect (APE) for historic structures was determined as those areas from which the disposal locations would be visible. A Phase I cultural resource survey was conducted to identify sites within this APE.

The archaeological survey identified one archaeological site near disposal Area 1 (see Figure ES-1). This site is marked on BFN drawings and it is expected that it would be avoided by any future activities. If avoidance is not possible, or should any future plans result in potential adverse impacts to the site, a Phase II archaeological survey would be required. Cox Cemetery, located near disposal Area 2, would also be avoided. No historic structures were identified within the APE. In consultation with the Alabama State Historic Preservation Office (SHPO), it was determined that no historic properties will be affected by Alternatives 1 and 2 under the commitments that all sites identified during the Phase I survey will be avoided.

Environmental Noise

Routine construction noise from the action alternatives would have an insignificant effect during the duration of construction activities. Some cooling tower and building construction noise would be noticeable above background at times, but it would take place during daylight hours and for a relatively short time period. The highest noise levels during construction would come from the site preparation and foundation work for additional cooling towers. Alternatives 2A and 2B would require two additional towers. Alternative 2C would involve replacement construction of four large towers and the addition of one large tower extending over a period of three to four years. Alternative 2D would require a single additional tower. These heavy construction phases require the largest and most equipment to be in operation, but they are expected to be completed in about three months per tower. The following construction phases of erection and finishing do not require as large or as many pieces of equipment.

The incremental increases in operational noise from the cooling towers for Alternatives 1, 2A, 2B, and 2D are insignificant. These are about a 1 dBA increase over current operational noise. This increase might not be detectable by most of the nearest residents, but it has the potential for a 1 to 2% increase in annoyance. The incremental increase for Alternative 2C is likely to be noticed and has the potential for about a 4% increase in annoyance. None of the alternatives has the potential for causing hearing loss or speech interference.

Although Alternative 2C has the potential to cause an operational noise increase greater than 3dBA, it would be an insignificant effect. The maximum potential effect of Alternative 2C is decreased for several reasons. First, frequently, less than all of the towers are operating; second, the towers operated an average of 17 days per year over the past five years; and third, the cooling tower noise is low frequency and continuous. Also, the towers operate during the hottest part of the summer when residential air-conditioning is used and windows are closed, eliminating any potential noise increase from inside the residences.

Public and Occupational Safety & Health (Non-Radiological)

The site Safety and Health Program will not be impacted or affected by license renewal and continuing to operate Units 2 and 3 for 20 years after the current licenses expire. If Unit 1 recovery and license renewal/extended operation is added to continuing operation of Units 2 and 3, there is still no change to the Safety and Health Program. However, during the construction/modification work in recovering Unit 1 injury rates would be expected to be higher than during periods of operation.

Radiological Impacts

Future occupational radiation exposures from continuing either two-unit or three-unit operation at Extended Power Uprate (EPU) power levels have been analyzed based on extrapolations from past and present data; it was concluded that worker radiation exposures will continue to be significantly less than the limits established by federal regulation. The average annual dose to workers and and the average annual dose per operated reactor will remain consistent with current BWR industry trends. The estimated cancer risk increase associated with the occupational dose forecast for either operational Alternative is bounded by the projected doses for license renewal analyzed in NUREG-1437, "Generic Environmental Impact Statement for License Renewal of Nuclear Plants."

TVA does not anticipate any significant changes to the radioactive effluent releases or exposures to the public from continuing two-unit BFN operations through completion of the license renewal period. EPU is projected to increase effluent releases proportionately, as would the addition of Unit 1. However, the refined calculated doses are a small fraction of the applicable radiological dose limits and the total exposures to the public from 3-unit operation at EPU are expected to remain a small fraction of the regulatory dose limits.

The design basis accidents addressed in the BFN UFSAR are independent of the age of the plant and are the same for each unit. Therefore, the extension of the operating lifetime of the plant from 40 to 60 years will not impact the analysis of these accidents. EPU to 120% of the originally licensed maximum thermal power level will affect accident analysis because the power level influences the amount of radioactive isotopes available for release; however, all radioactive releases are projected to remain well within regulatory limits.

Extension of plant life from 40 to 60 years will also proportionately impact the ability of safety related equipment to withstand the effects of accidents; this is because of age-related effects of continuing operational conditions (temperature, humidity, radiation, etc.). However, the BFN equipment qualification program ensures that safety-related equipment will remain qualified to operate as designed in its intended environment so as to perform its intended function. As part of this program, any equipment that cannot withstand the full 60-year life of the plant will be replaced on a predetermined maintenance schedule.

License extension with either two- or three-unit operation would be accommodated as it has in the past by the BFN Radiological Emergency Plan. Based on the BFN SAMA analysis and SAMA analyses completed to date at other nuclear plants similar to BFN, it is not anticipated that either Alternative 1 or Alternative 2 would result in justifying significant modifications.

Decommissioning Impacts

If the decision is made to extend operation of only Units 2 and 3, decommissioning would probably not be initiated for Unit 1 until cessation of all site power operations. Instead, Unit 1 would likely remain in its current non-operable status until any renewed licenses expire or a subsequent decision is made to recover and restart the unit. If Unit 1 is restarted, Unit 1 would join Units 2 and 3 in extended operation for an additional 20 years past expiration of the current licenses. Therefore, under either Action Alternative, decommissioning would be delayed by the 20-year license renewal period, providing an opportunity for decommissioning technology (including more advanced robotics) and the licensing framework to evolve and mature. In addition, it becomes more likely that a permanent spent fuel repository would be available prior to completion of decommissioning.