CHAPTER 2
Description of Alternatives, the Proposed Regenesys Facility, and the Preferred Alternative

This chapter contains a history of the formulation of alternatives, identification of alternatives eliminated from further consideration, a description of the No-Action Alternative and Alternatives A and B, a comparison of the environmental impacts of all alternatives, a summary of mitigation requirements, and identification of the preferred alternative.

2.1 History of the Formulation of Alternatives

The formulation of alternatives involved the following three-step process.

- Selection of the appropriate energy storage technology.
- Selection of a general location (substation) within the TVA service area for the energy storage facility.
- Identification of the specific alternative sites within this general location.

The Regenesys™ energy storage technology was analyzed based on *Energy Vision 2020* and a TVA-funded Electric Power Research Institute (EPRI) study. A summary of the EPRI evaluation is included in Appendix A.

Locations considered for the Regenesys™ facility installation were current substations, or possible future substation locations, where TVA's Transmission Power Supply (TPS) organization is considering projects to improve system stability or service to customers through additional delivery points. These locations were screened based on predetermined criteria, and the substation near CAFB was chosen. Details of this screening are included in Appendix A.

After further investigation and subsequent visits to CAFB, two possible installation sites were identified on or near the base. Appendix A contains additional information on the site identification process.

2.2 Alternatives not Considered in Detail

Energy Storage Technologies

As discussed in Appendix A, the EPRI study determined that Regenesys would most likely provide the lowest cost of operation on a life-cycle basis for multi-hour utility energy storage. Therefore, the following energy storage technologies were eliminated from further consideration for this demonstration.

- Pumped Hydroelectric Storage
- Compressed Air Energy Storage (CAES)
- Vanadium Redox Batteries
- Zinc/Bromide Batteries

Pumped Hydro Storage and CAES are well understood technically, are geographically restricted, and have major financial costs. Vanadium redox and zinc/bromide batteries have lower power and energy ratings and higher capital costs.

Locations

TVA evaluated a total of 25 locations for implementation of the technology based on the following predetermined criteria.

- Sufficient TVA-owned lands (at least five acres) on-site.
- Potential for land acquisition nearby.
- Close proximity to an international airport (allowing for ease of visitor travel to the facility once it was constructed).
- Need for frequency regulation, voltage support, and transmission upgrades (rated by projected costs associate with upgrades).
- Existence of end users with a need for premium power and potential to show significant reduction in frequency and duration of interruption in service.

The substation near Columbus Air Force Base was selected based on the evaluation explained in Appendix A. This location has the greatest potential to meet goals set for demonstration of this technology including frequency regulation and voltage support, having end users with a need for premium power, and potential to show significant reduction in frequency and duration of interruption in service.

2.3 The No-Action Alternative

Under the No-Action Alternative, the Regenesys™ Energy Storage Facility would not be constructed. If this alternative were selected, TVA's need to demonstrate a promising new technology that has the potential to eliminate most problems associated with storing electricity would not be met. Current peak power demands and power quality concerns would probably be addressed by using more conventional generating facilities and/or by adding or upgrading transmission lines.

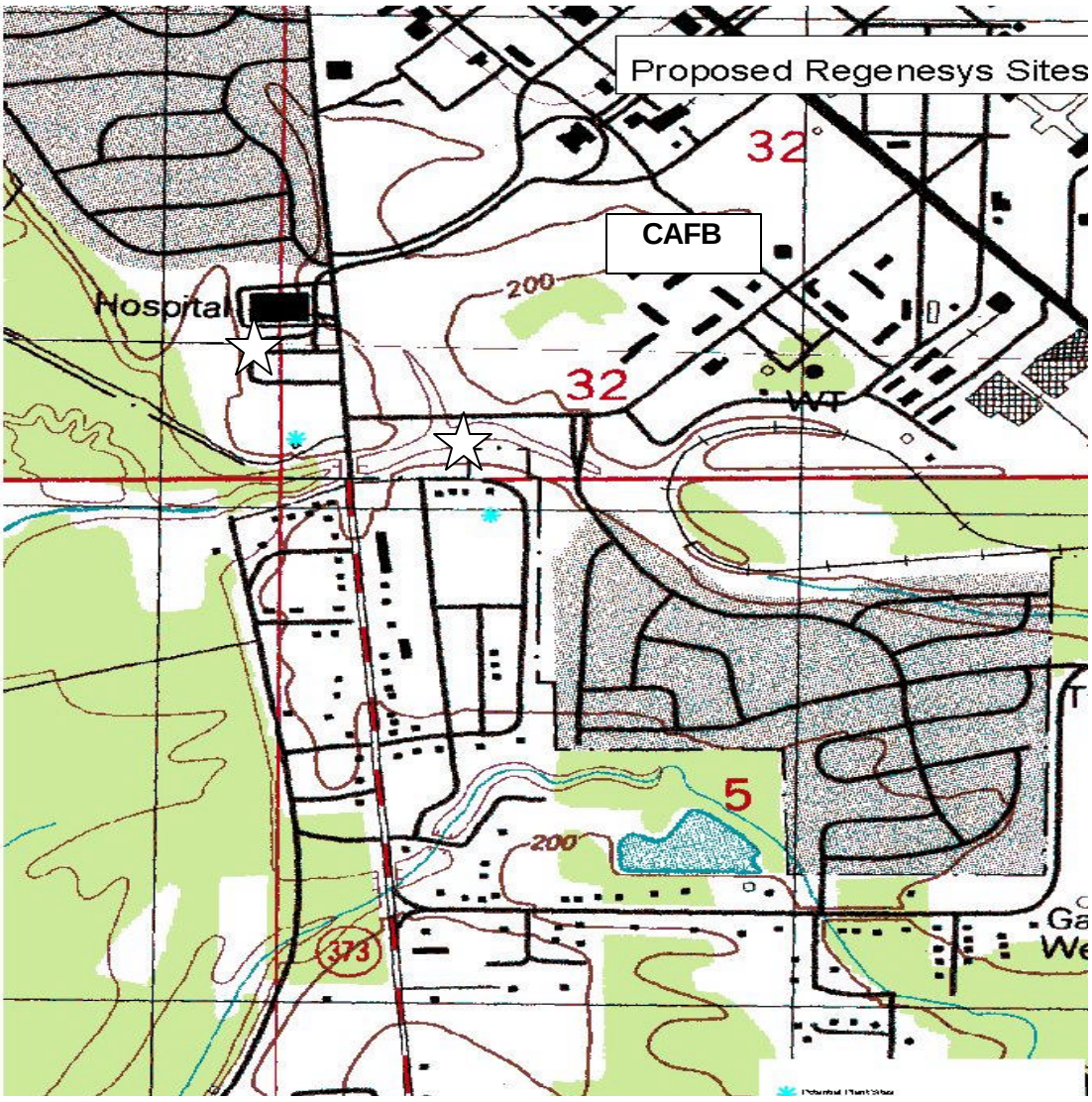
2.4 Alternative A

The Tennessee Valley Authority (TVA) proposes to install and operate a Regenesys™ facility in Lowndes County, Mississippi, on a portion of the privately owned mobile home park site adjacent to, and south of, the existing TVA substation at Columbus Air Force Base (CAFB). About six acres of the park would be purchased for the facility, which would occupy about four acres.

2.5 Alternative B

Under Alternative B, TVA would construct and operate the Regenesys™ facility on about four acres of CAFB property, approximately 400 yards west of the substation. The wastewater treatment plant that was once operated by CAFB on about two acres of this site has recently been razed.

The location of Alternative A and B is shown on Figure 2-1.



Proposed Sites

Figure 2-1 Proposed Regenesys ä Sites

2.6 Description of the Proposed Regenesys ä Facility

The principal components of the Regenesys™ Power Storage Facility are these:

- Regenerative modules located in a main-process building.
- Two electrolyte storage tanks.
- A process facility, including an electrolyte circulation system.
- A power conversion system, including an inverter/rectifier, transformer, and alternating current breaker.
- Control systems.
- Auxiliary systems that include electrolyte and power-conversion-system cooling, and an electrolyte management system.

The plant layout, including parking facilities, would cover approximately four acres. The process building (approximately 175 feet long, 65 feet wide, and 60 feet tall) would contain required modules, electrolyte circulation pumps, electrolyte supply headers, and associated pipework. The cylindrical electrolyte storage tanks (30 feet tall and approximately 65 feet in diameter) would be installed adjacent to the process building. One tank would hold 475,000 gallons of sodium bromide. The other tank would hold 570,000 gallons of sodium polysulfide. A wall would be erected around the tanks to serve as a visual screen. Minor modifications to the existing substation would be required to accommodate the electrical interface. The substation would be expanded, requiring a small amount of grading. The station fencing would be expanded and probably incorporated into the new fencing required for the Regenesys™ plant. Communications and control equipment would be installed at the Regenesys™ plant, the substation, and several remote locations on the TVA system. All work at the remote locations would be within existing TVA facilities.

The Regenesys™ Energy Storage Facility would store energy when demand for electricity is low and be used as a power source when demand is high. This facility is expected to release about 12 megawatts of electricity for a duration of several hours and operational for about 15 years.

Appendix B includes more information about the Regenesys™ technology.

Gaseous Emissions

During normal operation, air extracted from the process building would be treated prior to discharge into the environment. The process building would have intermittent, low–volume air extraction generated by standby and/or duty fans. Air from these sources could contain trace quantities of bromine. An additional exhaust header would serve the headspace of the electrolyte storage tanks, effluent tank, and process area sump. These two streams would be combined, routed through two carbon-bed adsorbers with in-series inter-stage gas monitoring, and directed to a 65-foot-high stack for discharge. The first adsorber would be designed to reduce bromine concentration in the vent stream from a maximum of 110 mg/m^3 to a concentration of less than 10 mg/m^3. A subsequent adsorber would further reduce this concentration to a level below 0.04 mg/m^3. Figure B-6, found in Appendix B, shows a conceptual view of the ventilation system.

A separate by-product, hydrogen, would also be produced from the electrolyte management process at a rate of approximately 2.8 lb per hour. The hydroxyl stage (i.e., the part of the

process in which hydrogen would be generated) would be located in a separate building outside the main process building. The process would be designed to keep hydrogen above its upper explosive limit (UEL) prior to discharge. The exhaust stream would then be vented to the atmosphere via a 20-foot-high stack. Additional design measures to ensure hydrogen remains outside its flammability region would include a nitrogen purge in the pipework and tanks (implemented prior to and after operation), a water seal pot in the stack to prevent back-diffusion of air, and a stack for hydrogen releases that would be separate from the main process stack from which small amounts of bromine would be emitted. This separation of bromine and hydrogen emissions would prevent the formation of hydrobromic acid.

A wet, mechanical draft-cooling tower would be employed for the removal of heat generated in the modules. The cooling tower would be equipped with drift eliminators to limit drift emissions to less than 0.005 percent of circulating water flow.

Liquid Effluent

The only liquid effluent from routine operation would be purge water from the cooling system. This would be generated at a rate of 5 gpm and discharged to the local municipal wastewater treatment facility.

The process building would be designed to collect any electrolyte spillage or wash-down water for subsequent routing to a 10,000 gallon chemical effluent tank. All spillage would be neutralized with caustic and removed off-site to a licensed treatment facility. It is expected that this tank would remain empty during normal operation.

Any spills in the tanker unloading area would be collected in localized sumps, and each electrolyte unloading area has its own sump. Any spills would be collected from these sumps using a portable collection tank and removed for treatment at a licensed facility.

Tanks would be designed to prevent any releases. Each tank would have secondary containment in the form of a double wall. The base of the screen wall would be concrete and serve as spill containment in the unlikely event that a release from the tanks would escape the secondary confinement.

Solid Wastes and By-Products

As part of the overall process, sodium bromide would have to be treated to keep it in a suitable chemical composition. Batches of this electrolyte would be drawn from the circulating electrolyte on its return to the main storage tank. These batches would then be transferred to, and processed in, the Electrolyte Management System (EMS). The EMS consists of a series of tanks and electrochemical modules that reduce bromine levels and adjust the pH in the sodium bromide electrolyte, and a crystallizer that removes by-product sodium sulfate. Sodium sulfate would be extracted to maintain efficiency of the system and be produced at a rate of approximately 126 lb per hour. The preferred disposal method for sodium sulfate is to sell it in the bulk chemical market. Should market conditions not support this disposal method, sodium sulfate crystals would be shipped to a licensed disposal facility.

2.7 Comparison of Environmental Effects of Alternatives

Operation of the Regenesys™ facility would have the same environmental effects regardless of whether Alternative A or B were selected, with the exception of some slight differences regarding access, connection to different water and wastewater systems, and residential proximity to noise sources. Impacts associated with construction and the sheer presence of the facility would be different due to different site conditions and surroundings.

The No-Action Alternative would have no direct impacts. However, actions would still have to be taken to improve the power supply to CAFB. TVA has calculated that it would need to build a new tap line approximately three miles long to the CAFB substation. The substation would also have to be enlarged to accommodate required upgrades. These system improvements do not meet the basic need of the demonstration and, because no detailed information is yet available on the proposed improvements, environmental impacts are not reasonably foreseeable. If the demonstration were not implemented, TVA would begin detailed planning and assessment of the environmental impacts associated with the system improvements.

Table 2.7-1, found at the end of this chapter, summarizes the impacts of the No-Action Alternative and Alternatives A and B.

2.8 Mitigation Requirements

Mitigation of noise impacts would be required if Alternative A were implemented, and mitigation of visual and aesthetic impacts would be required if either Alternative A or B were implemented. These requirements are summarized in Table 2.8-1 at the end of this chapter.

2.9 Identification of the Preferred Alternative

Alternative A is the preferred alternative.

Table 2.7-1 Summary of Environmental Impacts for the Regenesys™ Facility

Resource (Applicable Section)	Alternative A	Alternative B	The No-Action Alternative
Noise (3.2)	Construction noise would cause temporary disturbance and annoyance to the nearby residents. The closest residence to the cooling tower would be affected by operational noise.	The noisiest phases of construction might cause low levels of disturbance to occupants in nearby buildings.	No Impacts
Land Use (3.3)	The facility would change land use of approximately six acres of an existing mobile home park. This would result in the removal of approximately 10-20 mobile homes, demolition of two wood-framed homes, and temporary use of about 4 acres of open space for the construction facilities. Operation could result in some long-term changes toward industrial or commercial land use in the immediate vicinity.	The facility would be a change from the previous wastewater treatment plant, now razed, but no change in industrial classification of the site.	No Impacts
Visual and Aesthetics (3.4)	Construction of the facility would adversely impact the visual landscape for residents in the surrounding area. Operation would result in a minor steam plume from the cooling tower and slight increases in night brightness from lighting	Construction of the facility would adversely impact the visual landscape, locally. Operation would result in a steam plume from the cooling tower and slight increases in night brightness from lighting.	No Impacts
Air Quality (3.5)	Construction activities would generate temporary minor fugitive dust. Small amounts of particulate matter from the cooling tower, a small amount of hydrogen, and trace quantities of bromine would be emitted from operation of this facility.	The air quality impacts would be the same as those listed under Alternative A.	No Impacts
Socioeconomic (3.6)	Construction of the proposed facility would require about one year, with a maximum of about 40 workers. Any impacts on schools and other community services would be minimal. Operation of the proposed facility would require a smaller number of workers, with even less impact.	Impacts would be the same as those listed under Alternative A.	No Impacts
Water (3.7)	Storm water runoff during the project's construction and operation would be controlled through routine BMPs, resulting in no adverse effect should it enter surface or groundwater. Operational wastewater would be properly treated by the local wastewater treatment plant and have no adverse effects on receiving surface or groundwater. Spills would be controlled, so there would be no adverse effects on surface or groundwater. Construction is expected to require little or no foundation de-watering. Water required for construction and operational personnel and plant operation would be very minor and not significantly increase groundwater use in the area.	Impacts would be the same as those listed under Alternative A.	No Impacts

Table 2.7-1 Summary of Environmental Impacts for the Regenesys™ Facility (cont.)

Resource (Applicable Section)	Alternative A	Alternative B	The No-Action Alternative
Infrastructure and Utilities (3.8)	Small amounts of water would be required for construction and operation. The East Lowndes Water Company could easily meet this need. Small amounts of wastewater generated by operation could easily be treated at the Southgate Sewer Company. Small amounts of solid waste would be generated by construction and operation. At the end of the plant's lifetime, it would be dismantled. Most of the material would be recycled, and only a small amount of solid waste sent for disposal. The Golden Triangle Solid Waste Authority Landfill could easily accommodate this waste increase. Small amounts of by-product sodium-sulfate crystals would be shipped to a licensed treatment facility, if market conditions do not support sale. The small amount of additional traffic generated by construction and operation would not reduce the roadways' levels of service. Area roads, except the immediate access road, are in good condition for access and adequate to support traffic requirements during operation of the facility.	Small amounts of water would be required for construction and operation. The Columbus Water System could easily meet this need. Small amounts of wastewater generated by operation could easily be treated at the Columbus WWTP. Solid waste impacts would be the same as under Alternative A. Traffic and road impacts would be the same as those listed under Alternative A.	No Impacts
Earth (3.9)	Construction activity would require excavation and grading of approximately four acres, with only minor effect on regional soil resources. Earth work would be planned and conducted in such a manner as to minimize the duration of exposure to unprotected soils.	Construction activity at this site would occur within an area where physiography and geology have been previously disturbed and modified by prior construction, so there would be no new impact on the region's soil resources.	No Impacts
Hazardous Materials and Wastes (3.10)	Two electrolytes, sodium-bromide solution and sodium-polysulfide solution, would be stored in large double-walled tanks. These hazardous solutions would be contained on-site to prevent and contain releases and handled in accordance with all federal, state, and local laws and regulations, including RCRA requirements for waste management and Department of Transportation requirements for waste transport to minimize risk of exposure to humans or environment. Extremely small emissions of bromine gas, another hazardous substance, would be released during operation, but would be below all thresholds of possible concern. At the end of the plant's lifetime, these electrolytes would be pumped out and sold.	The impacts would be the same as those detailed under Alternative A.	No Impacts

Table 2.7-1 Summary of Environmental Impacts for the Regenesys™ Facility (cont.)

Resource (Applicable Section)	Alternative A	Alternative B	The No-Action Alternative
Cultural, Archeological, and Historic (3.11)	No impacts are expected due to previous disturbance of the site, and no historic structures or sites being in the area.	No impacts are expected due to previous disturbance of the site and no historic structures or sites being in the area.	No Impacts

Table 2.7-1 Summary of Environmental Impacts for the Regenesys™ Facility (cont.)

Resource (Applicable Section)	Alternative A	Alternative B	The No-Action Alternative
Biological (3.12)	There are no wetlands on-site or in the vicinity of the proposed action to be affected. No uncommon terrestrial communities, or otherwise unusual vegetation, occurs on the site of the proposed action so impacts to the terrestrial ecology of the region are expected to be insignificant. No occurrences of, nor suitable habitats for, federal- or state-listed plant or terrestrial animal species, including species listed as threatened or endangered, are associated with the site of this proposed action. Therefore, no construction or operational effects to rare plant or terrestrial animal species are expected.	Impacts associated with choosing this site would be similar to those listed under Alternative A.	No Impacts
Environmental Justice (3.13)	No disproportionate effects on disadvantaged populations are expected. No impacts are expected to be significant with proposed mitigation, and the area has a relatively low percentage of minority and low-income populations.	Impacts associated with choosing this site would be similar to those listed under Alternative A.	No Impacts

Table 2.8-1 Summary of Mitigation Requirements and Commitments		
RESOURCE	**MITIGATION**	
	ALTERNATIVE A	**ALTERNATIVE B**
Noise	Noise emissions from the cooling tower would be reduced by installing an acoustic enclosure around the tower. This would reduce the intruding noise level by 5 to 8 decibels and eliminate significant contribution to the ambient noise level.	No Mitigation Required
Land Use	No Mitigation Required	No Mitigation Required
Visual and Aesthetics	Existing vegetation along the north and northeast would be protected to maintain the limited visual buffer and ground level screening. Construction facilities would be located generally south and southwest of the plant to avoid disturbing the vegetation buffer. For the main building and screen wall, architectural materials and colors would be used similar to those preferred for new community facilities on CAFB. To the greatest extent practical, lower industrial elements, such as the cooling tower, tanker bays, and related yard features, would be enclosed within the screened area. Architectural details would be used to divide the large building surfaces into a series of smaller forms, thus reducing visual impact. As the final task of construction cleanup and reclamation, all undeveloped portions of the site would be reforested using a mix of 60 percent evergreen and 40 percent deciduous tree species. Supplemental evergreen planting for ground level would provide screening and increased buffer density for the closest residential units and CAFB. Shielded lighting would reduce the effective number of total lumens by 35 percent. Area lighting poles less than 40 feet would be used if possible.	Main structures would use the architectural materials and colors preferred for new buildings in community areas, as identified in CAFB design guidelines. One story of brick, and the upper three of dark metal, would provide optimum compatibility and the least visual contrast with the background. Architectural details would be used to divide the large building surfaces into a series of smaller forms that would reduce the visual impact of their mass. Trees along the south, east, and north sides of the site would be protected to maintain the limited visual buffer. Supplemental evergreen planting on the east and north would provide ground level screening and increased buffer density, along with other landscape planting mandated by CAFB design guidelines. Shielded lighting would reduce the effective number of total lumens by 35 percent. Area lighting poles less than 40 feet would be used if possible.
Air Quality	No Mitigation Required	No Mitigation Required
Socioeconomic Resources	No Mitigation Required	No Mitigation Required
Water Resources	No Mitigation Required	No Mitigation Required
Infrastructure and Utilities	No Mitigation Required	No Mitigation Required
Earth Resources	No Mitigation Required	No Mitigation Required

Table 2.8-1 Summary of Mitigation Requirements and Commitments (cont.)		
RESOURCE	**MITIGATION**	
	ALTERNATIVE A	**ALTERNATIVE B**
Hazardous Materials and Wastes	No Mitigation Required TVA commits to adhere to substantive provisions of 29 CFR 1910.119 (Process Safety Management of Highly Hazardous Chemicals), including those for proper equipment design, hazard assessment, operating procedures, employee training, and emergency planning. TVA commits to minimize seismic hazards to the Regenesys™ facility by adhering to the seismic provisions of the 1997 version of the International Conference of Building Officials (ICBO) Uniform Building Code (UBC) and the 1997 National Earthquake Hazards Reduction program.	No Mitigation Required Same commitments as Alternative A. Also, if Alternative B were selected, TVA would coordinate the treatment, storage, and disposal of toxic and hazardous materials with the Department of Defense, as provided in 10 U.S.C. Section 2692.
Cultural, Archeological, and Historical Resources	No Mitigation Required	No Mitigation Required
Biological Resources	No Mitigation Required	No Mitigation Required
Environmental Justice	No Mitigation Required	No Mitigation Required