Entergy

**System Energy Resources, Inc.**
1340 Echelon Parkway
Jackson, MS 39286-1995

CNRO-2004-00062

September 14, 2004

U. S. Nuclear Regulatory Commission
Washington, DC 20555-0001
Attention: Document Control Desk

DOCKET: 52-009

SUBJECT: Early Site Permit - Response to Request for Additional Information Letter No. 3

REFERENCE:

1. System Energy Resources, Inc. (SERI) letter to USNRC – Early Site Permit Application (CNRO-2003-00054), dated October 16, 2003.

2. USNRC letter to SERI – Request for Additional Information Letter No. 3 – System Energy Resources, Inc., Early Site Permit Application for the Grand Gulf ESP Site (TAC No. MC 1378) (CNRI-2004-00013), dated July 23, 2004.

3. SERI letter to USNRC - Response to Request for Additional Environmental Information Related to Early Site Permit Application (Partial Response No. 5) (CNRO-2004-00055), dated August 16, 2004

4. Entergy Operations, Inc. letter to USNRC – Revision to Security Plan, T and Q Plan, and Safeguards Contingency Plan Incorporating RAI Responses (GNRO-2004-00052); Docket No. 50-416; dated September 9, 2004.

5. SERI letter to USNRC - Early Site Permit - Response to Request for Additional Information Letter No. 2 (Partial Response No. 1) (CNRO-2004-00053), dated August 16, 2004.

CONTACT:

| | |
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DOCUMENT COMPONENTS:

One (1) CD-ROM is included in this submission. The CD-ROM contains the following five (5) files:

001_ESP-SSAR_DraftRev-1_Sept3-2004.pdf, 100 KB, publicly available
002_Draft Fig 2.2-5_Sept3-04.pdf, 5184 KB, publicly available
003_Lambert_email.pdf, 119 KB, publicly available
004_Personal Comm_Waves on MSR.pdf, 40 KB, publicly available
005_2.1-2 PA MARKUP.pdf, 635 KB, publicly available

In the referenced July 23, 2004, letter (Reference 2) the U.S. Nuclear Regulatory Commission requested additional information to support review of the SERI ESP Application. This letter transmits information as outlined in Attachment 1 to this letter.

Should you have any questions, please contact me.

I declare under penalty of perjury that the foregoing is true and correct.
Executed on September 14, 2004.

Sincerely,

George A. Zinke
Project Manager
System Energy Resources Inc.

Enclosure: One CD-ROM

Attachment: Attachment 1

cc: Mr. R. K. Anand, USNRC/NRR/DRIP/RNRP
Ms. D. Curran, Harmon, Curran, Spielberg, & Eisenberg, L.L.P.
Mr. W. A. Eaton (ECH) (w/o enclosure)
Mr. B. S. Mallett, Administrator, USNRC/RIV
Mr. J. H. Wilson, USNRC/NRR/DRIP/RLEP

Resident Inspectors' Office: GGNS

# ATTACHMENT 1

**SSAR Section 2.2, Nearby Industrial, Military and Transportation Facilities and Routes**

**Request:**

**RAI 2.2-1**

In reference to Section 2.1.2.1, provide a basis for the statement that "... it is extremely unlikely that such third party interests would ever be exercised so as to create an exception to Entergy Operations" control of the exclusion area."

**Response:**

This is explained in Part 2, Section 2.1.2.3, Mineral Rights, in the application. Also, see response to RAI item S2.1-1 contained in cover letter Reference 3 (ADAMS Accession No. ML042400269).

**Request:**

**RAI 2.2-2**

In Section 2.2.1, a description is given of the nearby airports and air routes. However, in Section 2.2.3, there is no discussion of the potential accidents and hazards related to aircraft activity in the vicinity of the Grand Gulf Nuclear Station (GGNS) ESP site. Aircraft hazards should be addressed with respect to the proposed site.

**Response:**

From SSAR 2.2.1 the following information regarding airports in the general vicinity of the Grand Gulf ESP site is provided:

1. Nearest airport: Tensas Parish airport (approximately 11 miles to the SW of the site);
2. Nearest general aviation airport: Vicksburg Municipal Airport (approximately 18 miles to the N-NE of the site)
3. Nearest commercial airport: Jackson International (65 miles to the NE of the site).

A more detailed listing of airports is provided in SSAR Table 2.2-6. There are no commercial airport facilities within 10 miles of the site (SSAR 2.2.2.5).

The nearest major air route, used primarily by commercial aircraft, is V245 which follows a SW-NE line and is approximately 10 miles SE from the site (See SSAR Figure 2.2-5). The next closest such route (V417), extending between Jackson, MS and Monroe, LA is more distant, at about 30 miles to the north of the site (SSAR 2.2.1).

SSAR Figure 2.2-5 reproduces a portion of the FAA sectional aeronautical charts for the New Orleans (71st Edition, November 28, 2002), Houston (70th Edition, October 3, 2002) and Memphis (69th Edition, October 3, 2002) sections. This figure illustrates routes V245 and V417 in the site vicinity. Flight routes utilized by the military for training purposes are designated as VR, IR, or FR routes. The closest such military flight route, as illustrated in Figure 2.2-5, is VR1072 which is SE of the site but beyond V245 at its closest point of approach to the site. One other VR flight route exists to the N-NW of the site (VR1032), but this flight route is north of V417 and is, therefore, greater than 30 miles from the site. IR161 - IR165 lies approximately 50 miles to the W-SW of the site at its closest point (Houston Sectional, 70th Edition, October 3, 2002). Thus, using the criteria of NRC RS-002 (3.5.1.6, II.1.b), the site is much greater than 5 miles from the edge of the closest military training route. This assessment of the proximity of the Grand Gulf site to general, commercial aviation, and military training flight routes was based on a review of recent, publicly available aeronautical or "sectional" charts. It is recognized that flight routes are subject to change and that some military flight routes may not be depicted on the sectional charts.

SSAR Table 2.2-6 lists airports within the vicinity of the site. Since all of these airports are greater than 10 miles, the appropriate criteria for the projected flight operations per year is $1000D^2$, where D = the airport to site distance in miles (RS-002, Section 3.5.1.6, II.1.a). Flight operations for each of the listed airports is less than 10% of this RS-002 criteria.

In summary, there are no commercial airports within 10 miles of the site. The airports meet the applicable $1000D^2$ criteria, considering projected annual operations and distance from the site. Per public aeronautical charts, no military training routes are within 10 miles of the site. And the nearest major route used for commercial flights is approximately 10 miles from the site. Based on this information, considering the acceptance criteria of RS-002 (Section 3.5.1.6), it can be concluded that the probability of aircraft accidents having the potential for radiological consequences greater than 10 CFR Part 100 exposure guidelines is less than $10^{-7}$ per year, and no further detailed analysis is warranted.

SSAR 2.2.3 will be revised as required to reflect the above additional discussions of aircraft hazards. Figure 2.2-5 will be revised to provide better clarity.

See files: 001_ESP-SSAR_DraftRev-1_Sept3-2004.pdf
002_Draft Fig 2.2-5_Sept3-04.pdf

**Request:**

**RAI 2.2-3**

In reference to Section 2.2.3.1.1, flammable vapor cloud explosion hazards are not anticipated on the basis of distance and the existence of a bluff 65 feet above the normal river level. Provide a basis for dismissing river traffic hazards involving natural gas releases. Specifically, consider the possibility of flammable vapor cloud formation involving delayed ignition and taking into account the positive buoyancy of natural gas as it relates to the 65-foot bluff elevation.

**Response:**

This response evaluates the risks, as requested, associated with a flammable vapor cloud resulting from a river transportation accident involving liquefied natural gas (LNG)[1]. The response is organized as follows:

1. a discussion of how river traffic hazardous spills have been evaluated in the past,
2. a discussion of a reasonably conservative LNG release and plume, and
3. a probabilistic evaluation of the LNG release plume.

The conclusion is that the risk of LNG plumes causing burns is low enough to support dismissing river traffic hazards involving natural gas releases as a credible design basis event for an ESP facility in the proposed location.

## 1. Past Evaluations of River Traffic Accidents and Spills

In 1981, Grand Gulf evaluated the risk of hazardous material spills from Mississippi River barge traffic (Reference 1). The conclusion was that the frequency of spills that resulted in such material being blown to the Grand Gulf site was $1.8 \times 10^{-6}$/yr, and that this low number, in combination with identified conservatisms used to generate that low frequency, made the issue sufficiently unlikely such that no further action would be required. The gases involved were primarily considered in light of toxicity, but flammable gases were included among those considered.

The 1981 work provides a basis for saying that river traffic spills are rare enough to be neglected. NRC Review Standard RS-002 (Reference 2) states that:

> The probability of occurrence of initiating events having the potential for causing consequences in excess of 10 CFR Part 100 exposure guidelines should be estimated using assumptions that are as representative of the specific site as is practicable. In the absence of a specific plant design, past review experience of existing plants and judgment should be factored into the determination of the need for identifying a site hazard as a design basis event. In addition, because of the low probabilities of the events under consideration, data are often not available to permit accurate calculation of probabilities. Accordingly, the expected rate of occurrence of an initiating event of approximately E-6 per year is acceptable if, when combined with reasonable qualitative arguments, the realistic probability can be shown to be lower.

[1] As is discussed later in this assessment, "LNG" can be used to apply to a range of products. The specific petroleum products considered in this assessment are defined later in the discussion.

The 1981 risk assessment is bounding for LNG for the following reasons:

1. The accident rate used in Reference 1 was applied to all barges containing hazardous chemicals. In a related letter (Reference 3), liquefied gases were identified as only a small fraction of this volume (<0.3%). Hence by direct proportion, liquefied gas releases of all types of liquefied gases would amount to a risk of about E-8.
2. The release rate did not credit the better containments associated with LNG as compared to other spills within the data base (which included, for example, fuel oil spills)
3. No correction was made for the low likelihood of maintaining oxygen-gas ratios in a combustible mixture in a drifting plume.

Other assumptions, such as the total number of river accidents and wind frequencies, remain reasonable and are referenced below.

The above information supports a conclusion that the 1981 risk assessment is bounding, and that the risk of an LNG plume is sufficiently low to meet the RS-002 guidelines. Nevertheless, further assessment of the LNG-specific risk is provided below to make clear the reason for concluding this is an extremely low probability event.

## 2. LNG Plume

LNG is a term that is used generically for a range of products, including cryogenically liquefied natural gas, other liquefied petroleum products, and liquefied natural gasoline (or drip gas). LNG may also be specifically used for liquefied natural gas. Liquefied natural gas as natural gas is primarily methane (minimum 75% for pipeline quality, typically closer to 95%). Other gaseous petroleum products that can be liquefied include blends of gases such as ethane, ethylene, and propane.

Gases liquefied by refrigeration are treated as liquid releases that then evaporate (Reference 11). The evaporation rate can be rapid, and pool fires can occur at the immediate spill site. If no ignition source is present, the evaporation rate can result in a plume from the site that can be flammable. The vapor plume will not detonate in such a fashion to cause an overpressure event. Rather, it will burn with a relatively slow deflagration rate of several feet per second. (Reference 5 identifies that LNG vapor explosions cannot occur unless the release is into a confined space.)

In order to evaluate the potential risk to the plant site, it was first determined whether a plume from an LNG release at the river could reach the plant site located approximately 1.1 miles distant (SAR 2.2.1, Reference 6). In order for the plume to be hazardous, the concentration of the plume must be above the lower flammability limit (LFL) for the gas.

### *2.1 Assumed Break Size*

The distance the plume travels is dependent on the rate of the release, the source volume available, and meteorological conditions. (Meteorological conditions are addressed later in this assessment). In the case of a release onto water, it is conservative to consider the water an infinite heat source and use an almost instant vaporization of the leak. Two leak rates were evaluated – one that is produced by flow through a hole 5 $m^2$, and one through a hole 1 $m^2$. The leak rate was approximated as

1-meter height of liquid flow over a weir 5 or 1 meters wide, using standard flow equations (Reference 10). A tank hole of either 1 $m^2$ or 5 $m^2$ is considered to be extremely conservative – for comparison, a single-ended pipe break in a 36" line is only 0.65 $m^2$. The maximum tank size, based on a U.S. Army Corps of Engineers review of Mississippi River traffic of LNG[2] past the plant site for the years 2000-2003 (Reference 7), was assumed as a worst-case release volume.

$$Q = 3.330\,(L-0.2H)H^{1.5}$$

where

Q is the flow out of the hole in $ft^3/s$

L is the crest length in feet (16.4 ft or 3.28 ft)

H is the crest height over the weir in feet (3.28 ft)

Using this release rate, the EPA software SCREEN3 (Reference 10) was used to determine the maximum concentration at various distances downwind of the plume at the elevation of the plant (50 feet above the river[3]). Note that SCREEN3 effectively sets the elevation difference to zero; and thus, no credit is taken for the plant's height above the river in this assessment. The maximum distance and the associated atmospheric conditions to generate a concentration greater than the LFL of the gas are as follows:

| **Component** | **Methane** | **Ethane** | **Ethylene** | **Propane** |
|---|---|---|---|---|
| Mass transport (tons) | 3200 | 3200 | 3200 | 3200 |
| Volume of tank ($m^3$) | 6833 | 5280 | 5095 | 5007 |
| LFL (% in air) (Reference 11) | 5 | 2.9 | 2.7 | 2 |
| Sp. Grav. (Reference 12) | 0.425 | 0.55 | 0.57 | 0.58 |
| MW | 16 | 30 | 28 | 44 |
| | | | | |
| **5 $m^2$ hole** | | | | |
| Flow rate, Q ($ft^3/s$) | 311.4 | 311.4 | 311.4 | 311.4 |
| Release duration (min) | 12.9 | 10.0 | 9.6 | 9.5 |
| Mass release rate (lb./s) | 8259 | 10689 | 11077 | 11272 |
| Distance to LFL (miles) | 1.25 | 1.8 | 2.8 | 1.8 |
| Pasquill Stability Class | D | D | D | D |
| Wind Speed (m/s) | 1 | 1 | 1 | 1 |
| | | | | |
| **1 $m^2$ hole** | | | | |
| Flow rate, Q ($ft^3/s$) | 51.91 | 51.91 | 51.91 | 51.91 |
| Release duration (min) | 77 | 60 | 58 | 57 |
| Mass release rate (lb./s) | 1377 | 1781 | 1846 | 1879 |
| Distance to LFL (miles) | <0.1 | <0.1 | <0.1 | <0.1 |

The smaller tank rupture (1 $m^2$) at no point greater than 0.062 miles downwind of the release miles (the first point evaluated was 100 m downwind) was able to exceed the LFL. In other words, by the time the plume had traveled a tenth of a mile from the

[2] The subject review collected shipment data for the Waterborne Commerce Statistics Center (WCSC) Commodity Code 2640, that is, "Liquid Natural Gas," shipped past mile-point 406 (Grand Gulf site) of the Mississippi River.

[3] Per SSAR 2.4.1.1 (Reference 6), the plant site is above Elevation 130' and the Mississippi River mean annual flood stage is 76.5.' Thus, the plant site is over 50' above the river.

release point, it was too diffuse to combust. Further analysis reveals that a rupture size of 3.2 $m^2$ is required in order to support a plume that will tentatively reach the plant site (1.1 mile sustained plume length).

The longest plume generated from the different component compounds reviewed is shown to be 2.8 miles. However, the SCREEN3 simulation assumes that the plume is fed continually for over 1 hour. It is noted that the duration of the plume of this magnitude is under 10 minutes. The distance the plume can travel while being fed is:

Wind Speed x Duration x (60 sec/min)(0.00062 mi./m) =

(1 m/s) x (10 min) x (60 sec/min)(0.00062 mi./m) = 0.372 miles

This is less than one-third the distance to the site. If the plume is no longer being fed, it will begin to dissipate more quickly. For the methane plume, the lower molecular weight corresponds to a larger volume and thus a longer spill duration – it reaches almost halfway to the site before it is no longer fed.

Conservatively, the plume is assumed to remain intact and reaches the site. A 1.25-mile sustained plume length is assumed.

*2.2 Plume Angle*

The plume width is evaluated by the SCREEN3 model and reported based on a standard deviation – in other words, as distance increases parallel to the direction of travel of the plume, the concentration decreases in a normal distribution. In order to be conservative, six standard deviations (99% of all the gas that has traveled that distance downwind) are used to assume the width of the plume. It is noted that most of this plume width is below the LFL. The plume standard deviation at 1 mile (1600 m) is 160 m. Six standard deviations makes the total plume width 960 m, or 480 m to each side.

The tangent of the angle from the centerline to the edge of the plume is calculated as the width of the plume to that side divided by the downwind plume distance.

Half angle of plume = atan (half of plume width/plume length)

= atan (480 m/1600 m)

= 16.7°

This is doubled to get the total plume angle, 33.4°. This is rounded to 35° to account for inaccuracies in the model and the impact of coherent shifts of the plume that can occur due to terrain.

## 3. LNG Barge Accident Risk Assessment

The overall risk is calculated based on the series of events that must occur in order for a flammable plume to reach the plant site. That is, an LNG container ship of sufficient size must be present within plume range of the site, the ship must have an accident, it must release the LNG, atmospheric conditions must be correct for a plume to exist and extend towards the site, and an ignition source must exist. Written in terms of probabilities, this is as follows, where the equation below represents that the risk per year is the product of the frequency of large LNG carriers per year f(ship), times the accident rate per ship P(accident|ship) which will be seen to be the product of the accidents/mile times the length of the path within plume distance, times the fraction of accidents that result in LNG release P(release|accident), times the fraction of time that the correct meteorological conditions exist to deliver the plume to the site P(correct met conditions), times the probability that an ignition occurs during the period after the plume reaches the site and before the plume dissipates below the lower flammability limit P(ignition).

Risk = f(ship)*P(accident|ship)*P(release|accident) *P(correct met. conditions)*P(ignition)

This does not include such dependencies as the relation between meteorological conditions and the probability of accidents. This particular dependency is judged to be conservative since accidents, such as collisions or grounding, are likely to be slightly more frequent during turbulent weather, and plume formation is more likely during calm weather. Nevertheless, since the formula is simple, conservative values are sought for each of the parameters to instill more confidence in the final risk value.

It is identified that a large conservatism exists in the equation in that it is assumed that any release would produce the worst-case plume. In point of fact, the longest credible plume is dependent on the size of the rupture, but there are so few LNG releases that little can be said accurately about the potential release rate. It is noted that no such plume has occurred since LNG ship transportation was initiated in 1959 (References 4 and 5).

In addition, LNG cargo is often transported in multiple tanks or in multiple compartments. While the accident leading to release can involve certain common failure mode aspects, that in itself has a distinct probability. However, for this assessment, the entire LNG cargo of the maximum shipment recorded in the study period was conservatively assumed to be involved in the plume generation.

*3.1 Ship frequency f(ship)*

The maximum LNG transport size on the Mississippi is 3,200 lbs. (6,900 $m^3$) (Reference 7), which has the potential under ideal meteorological conditions to produce a plume of 1.25 miles should a release hole of 5 $m^2$ suddenly occur.

The last 4 years of ship traffic data collected at Mississippi Mile 406 shows that there has been an average of 72,000 tons of LNG transferred along the Mississippi River near Grand Gulf each year. At a density of about 3.5 lbm/gal (typical for methane), this is a volume of 72000 tons/yr. * 2000 lbm/ton/(3.5 lbm/gal*264.17 gal/$m^3$) = 156,000 $m^3$/yr.

This volume is assumed to be carried only in ships of the maximum transport size (6,900 $m^3$). For ease of calculation, the assumption is made that 23 ships of 6,900 $m^3$ are utilized (23=156,000/6900). If smaller ships were used, there would be a proportionally higher rate of releases, but the plumes would be proportionally shorter in duration and the quantity of gas actually remaining in the plume when it reached the site due to the reduced release duration would be reduced. It is judged that these effects would cancel out, so that the size of the containers is not a critical input. Furthermore, it is believed that a majority of releases that might occur would be through ruptures considerably smaller than the 3.2 $m^2$ required to reach the plant site.

The "at-risk" distance is based on the maximum plume length of 1.25 miles for a plume assuming pure methane. Given that the plant site is 1.1 miles from the river, if the Mississippi were ruler-straight, this would be a river stretch of $(1.25^2 - 1.1^2)^{1/2}$ = 0.353 miles to the north and south, or 0.71 miles total. Given that the river uniformly curves away from the plant over this distance, using an assumption of a ruler-straight river makes this a conservative estimate for the total miles of "at-risk" river length.

The final result of this assessment is 23 ships/year * 0.71 miles = 16.3 ship-miles/year.

*3.2 Ship accidents and LNG releases P(accident|ship) and P(release|accident)*

A literature search did not identify a single, recognized value to use for the subject parameters. The approach was taken to find a value for releases per shipping mile (the product of these two terms).

The 1981 Grand Gulf site River Traffic Spill Risk Assessment (Reference 1) documented a record of 10 spills per 726-mile length near Grand Gulf in a five year period, involving a frequency of barge traffic of 200 to 400 barges per day. Using 300 barges * 365 as an annual rate, this gives a value of 10/(726*5*300*365) = $3x10^{-8}$ spills/ship mile.

This frequency is judged to be acceptable for use today. It has the conservative aspect that it is based on all types of spills, including fuel oil, whereas LNG containers are designed to high safety standards. For example, all LNG container ships that can enter the Gulf of Mexico must be double-hulled by maritime law (Reference 5).

The Center for Liquefied Natural Gas reports that since LNG transport began in 1959, over 60,000,000 miles of transport has been conducted with, according to US DOE statistics, only 8 spillage events (Reference 4). None of these events involved either ignition or fire. Details of the events contained within Table 4 of Reference 5 show that all but one spillage event were related to transfer or storage (there have been ship strandings and collisions, but none of these involved LNG releases). The only LNG release from a ship not in port was due to the accidental installation of a valve made of an aluminum alloy that failed at cryogenic temperatures (the Ship Arzew, location Algeria, 1977). Hence this is a historic release rate of only 1/60,000,000 = $1.7x10^{-8}$ spills/mile.

Another factor making the value of $3x10^{-8}$ releases/ship-mile conservative is that there is no credit for the size of the release. That is, the release is assumed to be from a very conservative $5m^2$ hole. As noted above, the only release of LNG came from a failed valve, which would not have produced much of a plume at all. Presumably, the majority of spills on the Mississippi River were from holes much smaller than 5 $m^2$.

*3.3 Probability of the Correct Meteorological Conditions P(correct met conditions)*

The first meteorological condition to be considered is the wind direction. Wind Roses collected from the Grand Gulf Met Tower demonstrate that winds from the west are infrequent. A glance at a typical wind rose (Figure 1 below) leads to the conclusion that should a plume release occur, it probably would not head towards the site, but would rather head along the river (north or south) or towards Louisiana away from the site (wind blowing from the east).

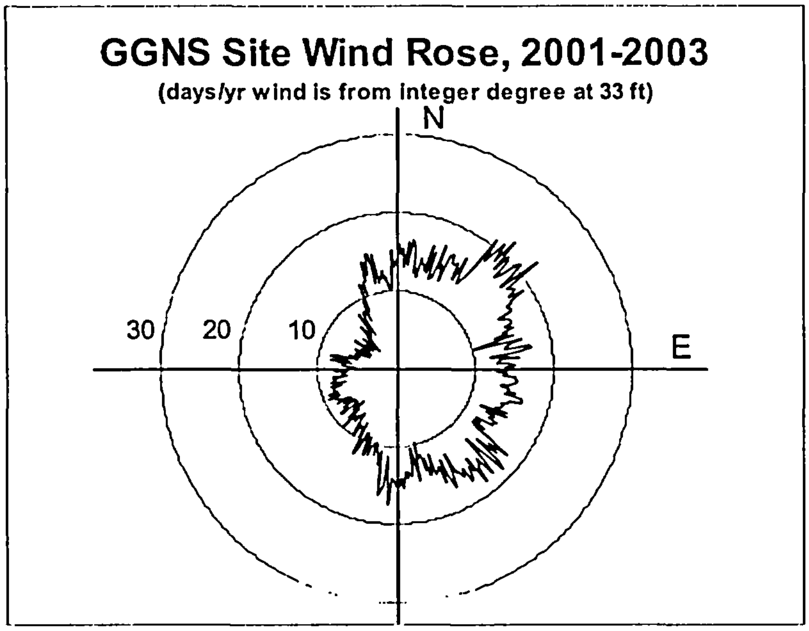


Figure 1: Site Wind Rose showing Rarity of Winds from the West

In order to determine the impact of this wind frequency, a conservative envelope of the "at-risk" wind directions had to be developed. It is calculated that the plume width angle might be as much as 35 degrees. If each point on the river is considered, the "at risk" wind direction for each point would be the angle to the site +/- 17.5 degrees. An integration process could be used to determine the fraction of time each wind direction would be an "at-risk" direction as the hypothetical barge moved along the river, however, this would be both complex and would fail to address the possibility of a wind shift moving the plume as a whole.

Instead, a simple bounding approach is taken. The ship's journey is divided into two legs, south and north of the site. Each extreme point's limiting angle is defined. Then, the "at-risk" wind directions are calculated based on maximum credible plume size, river and site relationship, and standard geometry. Based on the nearest distance from the site to the river of 1.1 miles, the at-risk wind directions were determined to be any wind blowing between the directions of 44.1° and 107.5° when the transport vessel is south of the plant, and between 72.5° to 135.9° when the vessel is north of the plant. This is clearly more conservative than a point release and a wind within a tight range of 35°, but it addresses the movement of the vessel through different potential wind angles. Note that these are "blown towards" directions, so the ranges in terms of standard wind directions (which are "blown from" angles) are these plus 180 degrees.

Wind data and Pasquill Stability Class data, by hour, was collected for the MACCS severe accident consequence analysis (Reference 8). That same data can be used to determine the frequency of meteorological conditions that would blow a LNG release plume towards the plant site.

The meteorological data is reviewed to see the fraction of time that the wind directions lie within these "at-risk" zones, recognizing that the two zones overlap. It is also recognized that this probability is going to be multiplied by the probability of a LNG release that has a 50% chance of being to the north, and a 50% chance of being to the south of the plant. Therefore each wind direction is given the following test:

1. If an hourly wind direction lies within the "south range" assign a value of 0.5.
2. If an hourly wind direction lies within the "north range" assign a value of 0.5.
3. If an hourly wind direction lies within both ranges, assign a value of 1.0.

Summing up the test results for one year of data (2001 data used), and dividing by the number of good hours of data, gives a probability between 0 and 1. Multiplying this by the frequency of release per year gives a bounding value for the probability of a release that drifts in the direction of the site.

This review of the 2001 data with the assumed lengths discussed above indicates that the winds were in the "at-risk" directions only 11% of the time. This is a reasonably conservative result considering Figure 1. Note that the 1981 risk assessment (Reference 1) used a parallel development and 1970s era meteorology data to determine that the wind would blow in the direction of the plant site 8% of the time. These results are sufficiently in agreement to provide confidence in the methodologies.

An additional test is made for the necessary atmospheric stability. Only very stable air can form and support a flammable plume. At higher wind speeds (low Pasquill Stability Classes) the mixture is not correct, and the LNG vapor disperses harmlessly. Therefore an additional test is applied to the summation describe above. In this test, the values are assigned when the wind direction is correct, only if the Pasquill Stability Class is 4 or higher. When this requirement is added, the probability of appropriate meteorology conditions for the plume formation and extension to the site is reduced to just 6% (0.06) for the 2001 data.

*3.4 Ignition of the plume P(ignition)*

This term is conservatively set to 1.0. It is noted in Reference 5 that no LNG transport releases or accidents involved LNG combustion. It is therefore a high probability that any release would not be ignited immediately at the crash site. Similarly, there are few ignition sources between the river and the plant site.

Given the unlikely meteorological conditions to drive a flammable plume mixture to the site, it is highly probable that an ignition source will exist there. Any open flame, cigarette, spark, or such thing would be sufficient. Therefore, it is conservative but reasonable to assign a probability of 1.0 to the ignition source parameter.

*3.5 Results*

The data generated above is repeated here:

f(ship) = 16.3 ship-miles/yr.

P(accident|ship)*P(release|accident) = $3\times10^{-8}$ release/ship-mile

P(correct met conditions) = 0.06

P(ignition) = 1.0

Therefore, by the following equation:

Risk = f(ship)*P(accident|ship)*P(release|accident)

*P(correct met conditions)*P(ignition)

the risk is numerically equal to:

$$\text{Risk} = 16.3 * 3\times10^{-8} * 0.06 * 1.0 = 3\times10^{-8}\ \text{yr}^{-1}$$

*3.6 Conclusions*

This risk assessment used the following conservatisms to determine that the risk of an LNG release plume reaching the plant site has a risk value of about $3\times10^{-8}$.

- Conservatively assumed that all LNG that is transported past the site is transported in barges large enough to generate a LNG plume that would reach the site
- Conservatively overestimated the amount of LNG shipped past the site due to the broad definition of "LNG" used for measuring shipping tonnage, specifically of liquefied methane, ethane, propane, and ethylene
- Conservatively estimated the length of river at which point a release could reach the site by assuming a release at the shoreline closest to the plant
- Conservatively ignoring that the section of the Mississippi adjacent to the plant is wide (>3000 ft), with no blind bends, no rocks, no sandbars, no unusual currents, and no bridges or loading transfer facilities
- Conservatively ignored the elevation difference between the river and the ESP site which would have contributed to some extent of plume dissipation
- Conservatively assumed that the gas contents of all tanks and compartments on a given vessel are available to support and sustain plume generation, whereas it is expected that multiple separate containers may be used
- Conservatively assumed any LNG release would be via a 5 $m^2$ hole to maximize the estimated plume (the only experienced LNG release from a ship at sea was through the small break of a failed valve)
- Conservatively assumed a wide range of wind angle amounting to about 60°, whereas the predicted plume is only 35°, and
- Conservatively assumed the LNG plume would not ignite until it reaches the site.

The overall conclusion is that the low frequency of $3\times10^{-8}$/yr, combined with the justification that the real frequency is even less, assures that the criteria of Review Standard RS-002 is satisfied, and flammable vapor cloud formation from LNG spills on the Mississippi River is not a significant risk to the Grand Gulf ESP site.

References:

1. Letter, L.F. Dale of the Mississippi Power and Light Company to Harold Denton of the NRC, Subj.: "Grand Gulf Units 1 and 2 Docket Nos. 50-416 and 50-417, Transmittal of Proposed FSAR Changes and Responses to NRC Questions," AECM-81/352, 9/23/81, containing an attached report "Potential Transported Toxic Gas Risks on the Mississippi River"
2. NRC Review Standard RS-002, "Processing Applications for Early Site Permits," SECY-03-0227, 12/31/2003
3. Letter, L.F. Dale of the Mississippi Power and Light Company to Harold Denton of the NRC, Subj.: "Grand Gulf Units 1 and 2 Docket Nos. 50-416 and 50-417,

'Transmittal of Proposed FSAR Changes and Responses to NRC Questions," AECM-81/316, 8/24/81, containing an attached report "Potential Toxic Gas Risks Transported on the Mississippi River"

4. "LNG Vessel Safety," the Center for Liquefied Natural Gas Web Page, http://www.lngfacts.org/marine_information/vessel_safety.html
5. "LNG Safety And Security," University of Houston Institute for Energy, Law & Enterprise, October 2003
6. Grand Gulf Early Site Permit Application, Site Safety Analysis Report, October 2003
7. "WCSC Request #5938," e-mail report from Mr. James J. Lambert, MVN, Waterborne Commerce Statistics Center, New Orleans, LA, 12 August 2004

   See file: 003_Lambert_email.pdf
8. "MACCS2 Assessment of Severe Accident Consequences," Enercon Calculation ENTO002-CALC-012, Rev. 0, July 30, 2004
9. Grant, D. M., and Dawson, B. D., "Isco Open Channel Flow Measurement Handbook," 5th Ed., 1997
10. EPA-454/B-95-004, "SCREEN3 Model User's Guide," September 1995
11. EPA 550-B-99-009, "Risk Management Program Guidance for Offsite Consequence Analysis," April 1999
12. Yaws, C. L., "Physical Properties: A Guide to the Physical, Thermodynamic and Transport Property Data of Industrially Important Chemical Compounds," McGraw-Hill, 1977

**Request:**

**RAI 2.2-4**

In reference to Section 2.2.3.1.1, it is noted that a probabilistic analysis of bulk shipments of ammonia was made for the GGNS and submitted in a letter to the NRC, dated September 23, 1981. Indicate to what extent the conclusions of the GGNS analyses included consideration of control room habitability system design and, if so, how these would be addressed for a new facility.

**Response:**

The subject probabilistic analysis (referenced in SSAR 2.2.3.1.2) provided a highly conservative assessment of the probability of an ammonia barge being involved in a serious accident on the relevant portion of the river such that a hazard to control room personnel might exist from an uncontrolled toxic gas release. The analysis was based on an assessment of accident frequencies on the Mississippi River between Baton Rouge, Louisiana and Cairo, Illinois. The analysis also considered the topography of the area, the meteorological conditions in the vicinity of the site, and the portion of the river where an accident could pose a hazard to control room personnel.

Overall, the subject 1981 analysis was a risk assessment of accidents on the river and took no credit for the Grand Gulf Unit 1 control room habitability system design. Therefore, the conclusions of the analysis are considered to be independent of the design of the new ESP facility.

**Request:**

**RAI 2.2-5**

In reference to Section 2.2.3.1.1, the probability of a chlorine accident on the Mississippi River is estimated to be about $1.8 \times 10^{-4}$ per year and it is stated that this is within NRC acceptance criteria. Clarify the specific acceptance criteria considered in this case.

**Response:**

The probability value stated in SSAR 2.2.3.1.1 was incorrect, resulting from a typographical error. The correct probability of a chlorine accident on the Mississippi River is approximately 1.8E-7 per year as discussed in Amendment No. 25 to the GGNS Facility Operating License (No. NFP-29), dated December 3, 1986 and Mississippi Power & Light Company letter to the NRC, dated June 26, 1986. As stated in the NRC Safety Evaluation Report accompanying Amendment No. 25, a probability of E-7 meets the NRC Standard Review Plan Section 2.2.3 acceptance criteria of less than E-6. This is also consistent with NRC Review Standard RS-002, Section 2.2.1 - 2.2.2. SSAR 2.2.3.1.1 will be revised to show the correct probability.

See file: 001_ESP-SSAR_DraftRev-1_Sept3-2004.pdf

**SSAR Section 1.4 Conformance with Regulatory Requirements and Guidance**

**Request:**

**RAI 1.4-1**

Please describe why the following regulatory guides (RGs) are not mentioned in Table 1.4-1:

RG 1.27, "Ultimate Heat Sink for Nuclear Power Plants," RG 1.102, "Flood Protection for Nuclear Power Plants," and RG 1.113, "Estimating Aquatic Dispersion of Effluents from Accidental and Routine Reactor Releases."

**Response:**

Regulatory Guide 1.27, "Ultimate Heat Sink for Nuclear Power Plants." A regulatory position on Regulatory Guide 1.27 will be established at COL once the design for the ultimate heat sink is defined and finalized.

Regulatory Guide 1.102, "Flood Protection for Nuclear Power Plants." Appropriate and required flood protection for safety-related structures, systems, and components identified in Regulatory Guide 1.29 will be established at COL once the exact facility design is defined and finalized. A regulatory position on Regulatory Guide 1.102 will be established at that time.

Regulatory Guide 1.113 "Estimating Aquatic Dispersion of Effluents from Accidental and Routine Reactor Releases." A regulatory position on this guide will be established at COL to support the final analysis of accidental and routine liquid releases. See also response to RAI 2.4.13-1.

**SSAR Section 2.4.1, Hydrologic Description**

**Request:**

**RAI 2.4.1-1**

Please provide survey coordinates (including elevations) for the bounding areas of all ESP safety-related structures. Also provide the coordinates of existing aquifers in the bounding areas, particularly perched aquifers.

**Response:**

The Universal Transverse Mercator (UTM) Grid Coordinates for the center of the location of the power block area for a new facility is approximately N3,542,873 meters and E684,021 meters, UTM Zone 15. This corresponds to approximately 32° N latitude 91° 3' W longitude. Refer to Figure 2.1-1 in the ESP SSAR. Safety related structures would be contained within the proposed power block area indicated on the figure.

Figure 2.4-37 in the ESP SSAR provides a cross-section of the ESP site, including that portion of the site designated as the proposed power block area. The figure provides an indication of the regional groundwater table for the area. The perched water table is indicated for the existing Unit 1 plant area.

Previous site investigations are detailed in the GGNS Unit 1 UFSAR Section 2.4, including extensive subsurface data obtained from borings. This data is summarized in the ESP SSAR Section 2.4. In addition, four borings were drilled as part of the ESP site geotechnical investigation, as detailed in section 2.5.4 of the ESP application. The conditions encountered during the geotechnical investigation (stratigraphy, material descriptions, and contacts) are consistent with those found during the initial site investigations documented in the GGNS UFSAR. Direct groundwater measurements were not obtained during the ESP investigation; however, borehole seismic velocity P-S surveys were used to estimate the groundwater table location. The estimated groundwater table ranged between 70 and 100 feet below the ground surface, corresponding to elevations between 55 and 63 ft msl. The groundwater levels and gradient are shown on the cross sections in SSAR Figures 2.5-75 through 2.5-77. As stated in section 2.5.4.2 of the SSAR, it is possible that shallow perched water could form in parts of the loess during periods of high rainfall, especially over finer-grained zones. Such perched zones likely would dissipate rapidly after cessation of heavy rainfall.

Additional detailed assessment to define the location and extent of perched aquifers would be conducted at COL when the plant design and location are finalized.

**Request:**

**RAI 2.4.1-2**

Please describe how de-watering systems may be utilized in the design of future reactor(s).

**Response:**

During excavation of the existing GGNS Unit 1 power block, the use of tie-back walls effectively restricted dewatering to a localized area. It is anticipated that dewatering would be required for construction of a new facility on the ESP site. Dewatering wells would be installed, if necessary, to support plant construction and operation. Therefore, specific well locations and well design details will be provided at COL when the plant design and layout are finalized.

**Request:**

**RAI 2.4.1-3**

Please explain how flooding from localized intense precipitation will be handled without interfering with safety-related structures of the new reactor(s).

**Response:**

The GGNS plant site has a plant yard grade elevation of 132.5 ft (SSAR Section 2.4.1.1). The proposed site for a new facility is in a location adjacent to the existing GGNS facility (SSAR Section 2.4.3). The design flood considerations for the site areas are based on the local drainage areas which can be seen on SSAR Figure 2.4-10. A specific plant design for a new facility has not been selected; therefore, the final plant grade has not been determined.

As stated in SSAR Section 2.4.2.3, the estimated maximum floodwater elevations, resulting from local intense precipitation, do not exceed 133.25 feet msl. This is the maximum flood water elevation from the PMP at the existing GGNS site and, overall, is considered valid for the new facility on the proposed ESP site (SSAR Section 2.4.2.3). All safety-related systems, structures and components (SSCs) for the new facility would be located above maximum flood elevation, or flood protection (drainage provisions, grading, culverts, dams, water-tight doors, etc.) would be provided such that the requirements of GDC-2 and 10 CFR 100 would be met. See also, the response to RAIs 2.4.2-3 and 2.4.2-4.

**Request:**

**RAI 2.4.1-4**

The application states that there will be a need for an 85,000 gpm service and makeup flow for the new facility. Please explain how these estimates were calculated.

**Response:**

As stated in SSAR Section 2.4.11.4, normal makeup flowrate to the plant would be approximately 50,320 gpm, and maximum expected makeup flow is approximately 85,000 gpm. SSAR Table 1.3-1 shows specific system uses of this makeup water, and the estimated maximum and normal or expected amounts required. This value for the proposed facility's maximum makeup requirement was provided in the SSAR primarily for the purpose of demonstrating site suitability, and for offering a comparison with the historical low river flow to show river capability as a water supply. As stated in SSAR Section 2.4.11.2, this maximum makeup value is approximately 0.2% of the minimum historical river flow and thus has insignificant impact on the river's capability as a cooling water source for this site. This parameter (maximum makeup demand) was not used in the SSAR for the analysis of features important to safety.

As discussed with the NRC Staff in the site visit of June 30, 2004, it was not intended that this makeup value of 85,000 gpm be understood as a limiting parameter to be included as bases for the early site permit. A review of the SSAR text and Table 1.3-1 will be conducted to insure that those parameters and values that were actually used in the SSAR analysis of features important to safety are clearly identified and treated as a bases for the SSAR. SSAR revisions will be provided, as required, at a later date.

This river water makeup flowrate was also used in the evaluation of environmental impacts to the site. The value of 85,000 gpm, developed by the PPE process, was based on a review of a range of plant technologies to establish a bounding makeup water requirement as described in ER 3.4.2.1. The ESP Environmental Report (ER) Figure 2.3-29 also provides details regarding the estimated plant water needs.

## SSAR Section 2.4.2, Floods

### Request:

RAI 2.4.2-1

Please provide for the road height above Culvert 9 (Stream A) and survey coordinates (including elevation) of Culvert 1 (Stream B).

### Response:

Refer to SSAR Figure 2.4-21 for road height above Culvert No. 9. Road bed height is 125' msl at Culvert No. 9.

For details of Culvert No. 1 refer to SSAR Figures 2.4-18, 2.4-20 Sh. 2, 2.4-23 and 2.4-24, and in SSAR Table 2.4-12. The survey coordinates for the center of Culvert 1 are N548,692.44 and E277,342.18. The inlet elevation is 107.50 feet msl and the outlet elevation is 103.17 feet msl. The length is 230 feet, and the diameter is 180 inches.

### Request:

RAI 2.4.2-2

The probable maximum flood (PMF) for the Mississippi River is estimated based upon the flood defined by U.S. Army Corps of Engineers (USACE's) design project flood (DPF). In calculating the PMF, twice the DPF was used to estimate the PMF. According to the reference cited in the application, a range of 2.5 to 1.67 times the DPF was suggested (corresponding to a DPF to PMF ratio of 0.4 to 0.6, respectively). Why was the number of 2.5 times the DPF not used to estimate the PMF?

### Response:

The text in question in the SSAR (Section 2.4.3.4.1, last paragraph) is taken from the GGNS Unit 1 UFSAR. In the UFSAR it is stated that the standard project flood (SPF) is generally 40 to 60 percent of the PMF. And the DPF is equivalent approximately to the SPF but probably higher. It was considered conservative in the UFSAR analysis to use a mid-point of 50 percent. This produced an estimated PMF of 6.6 million cfs.

Section 2.4.3.5, Water Level Determination, in the SSAR (taken from the GGNS Unit 1 UFSAR) indicates that a flood which produces a peak discharge of about 6.6 million cfs will overtop the levee with maximum elevation of 103 ft. (which can contain about 3 million cfs) and inundate the wide alluvial floodplain west of the levee. The discharge capacity of the floodplain west of the levee at water level elevation of slightly above 103 feet is conservatively estimated using Manning's roughness coefficient of 0.1, slope of floodplain of 0.2-ft./mile and floodplain width of 60 miles. Based on this analysis, the total river and floodplain discharge capacity for water level elevation slightly above 103 feet is about 11 million cfs, which is far greater than the estimated PMF discharge of 6.6 million cfs.

Therefore, use of a factor of 2.5 times the DPF to determine PMF would not change the conclusions of the analysis for the GGNS ESP site.

**Request:**

**RAI 2.4.2-3**

The application states that all safety-related structures, systems and components for the new facility would be located above the maximum flood elevation, or flood protection would be provided. Since the plant grade level is above the PMF level, please explain what parts of the new facility might need locally intense precipitation flood protection and why.

**Response:**

The referenced statement comes from SSAR Section 2.4.2.2. This section addresses flooding in broad terms and includes considerations of both Mississippi River floods and the impact of the probable maximum precipitation (PMP) on the site.

As stated in SSAR Section 2.4.3, the maximum water surface elevation due to a PMF flood in the Mississippi River is controlled by the levee elevation on the west bank (103 feet msl at GGNS). Thus, the maximum water surface elevation due to a PMF flood in the Mississippi River is about 29 feet below the proposed new facility grade elevation of approximately 132.5 feet msl. Since the proposed site for a new facility is located on the bluffs on the east side of the river, the maximum PMF water surface elevation from a Mississippi River flood would not affect any safety-related structures of the new facility. This evaluation is separate from that conducted with regards to probable maximum precipitation.

Potential flooding of the site due to probable maximum precipitation is discussed in Section 2.4.2.3 of the SSAR. The estimated maximum floodwater elevation for the site in its existing configuration does not exceed 133.25 feet (as described in SSAR Section 2.4.2.3). It is anticipated that a new facility on the ESP site in the proposed power block location would maintain (approximately) the existing plant grade elevation of 132.5 ft. msl. The plant yard for a new facility would be graded such that runoff is directed away from existing site buildings, and buildings for a new facility. Assuming that final grade, in relation to the location of safety related equipment, is such that flooding of such equipment is not possible during a PMP event, flood protection would not be needed. However, as noted in SSAR Sections 2.4.2.2 and 2.4.10, once the final plant design and plant grade are established (that is, at COL), the need for flood protection would be re-evaluated.

**Request:**

**RAI 2.4.2-4**

The application states (page 2.4-4) that the flood waters do not exceed 133.25 feet mean sea level (MSL). Please provide details that support this calculation.

**Response:**

The detailed discussion of flooding, as a result of probable maximum precipitation for the GGNS site, is provided in the GGNS Unit 1 UFSAR Section 2.4.3.5. Specific reference to and the basis for the maximum PMP elevation of 133.25 ft. is provided in the GGNS UFSAR in Section 2.4.3.5.3, Plant Area.

As stated in the ESP SSAR:

"The effects of local intense precipitation at the GGNS site have been evaluated in the GGNS UFSAR (Reference 8). This information has been reviewed and is considered to be valid for the determination of maximum floodwater elevation that could reasonably and conservatively be expected for a new facility. The relevant sections of the GGNS UFSAR are included below, with updated information as needed for evaluation of flooding concerns for a new facility. Consistent with the GGNS UFSAR, the position regarding Regulatory Guide 1.59 (as described in UFSAR Appendix 3A) remains unchanged. The PMF for the two local streams close to the plant site has been estimated based on the unit hydrograph method in accordance with Regulatory Guide 1.59 (Reference 8).

The forecast effect of a local probable maximum precipitation (PMP) event on the adjacent drainage areas and site drainage systems is based on the evaluations discussed below through Section 2.4.3.5. The estimated maximum floodwater elevations do not exceed 133.25 feet msl."

The calculation was done specifically for GGNS Unit 1, but it is felt that with the ESP facility on the same grade as the existing facility, and given the inputs and assumptions used in the Unit 1 analysis. Again, as stated in the SSAR Section 2.4.2.3: "The runoff model in the original GGNS analysis used a very conservative assumption, in that the runoff coefficient (i.e., the percentage of rain that appears as direct runoff) was set at 1.0. (See Section 2.4.2.3.3.2.3, Peak Discharges). This assumption essentially models the drainage basins as if they were covered, such that all rainwater is allowed to run off without benefit of soil infiltration. Therefore, this evaluation is considered valid for a new facility located on the proposed ESP Site."

**SSAR Section 2.4.3, Probable Maximum Flood on Streams and Rivers**

**Request:**

**RAI 2.4.3-1**

Please explain how wave runup calculations were bounded through the examination of the Combined Events Criteria indicated in American Nuclear Society (ANS) 2.8 1992 Standard. Please also discuss coincident wave calculations and the basis for applying a 40-mph design wind.

**Response:**

Wind wave calculations are discussed in detail in the ESP SSAR Section 2.4.3.6 with results of the calculation summarized in SSAR Table 2.4-14. The wave height calculation was performed in accordance with the procedures described in the Corps of Engineers Shore Protection Manual. This calculation used an overland wind speed of 40 mph, and the wind velocity over water was assumed to be 1.3 times higher than over land. The resulting wind speed over water used in the calculation was 52 mph. The resulting water surface elevation due to wind-wave activity coincident with the PMF on the Mississippi River was 108.8 feet. Thus, the maximum water surface elevation due to a PMF flood in the Mississippi River is about 23.7 feet below the proposed ESP plant grade elevation of 132.5 feet msl.

The ANS 2.8-1992 Standard indicates that the 2-year annual extreme mile wind speed may be used as a starting base. According to Figure 1 of this reference, the wind speed for the GGNS area is <50 mph but >40 mph. The fastest hourly averaged wind speeds at Grand Gulf and Vicksburg (1997-2001) were 31 mph and 33 mph, respectively, in 1999, so the value used in the original calculation is more conservative than measured values at GGNS.

Even if the wind speed were to be increased to 65 mph (using the most conservative range from Figure 1, this would be 50 mph times 1.3), the new wave height would be: 4.4 feet x $(65/52)^2$ = 6.9 feet. The margin to the proposed new plant elevation would still be 21.2 feet. This is not a significant change from the original analysis, and does not pose a safety hazard for the site due to flooding from the Mississippi River.

**Request:**

**RAI 2.4.3-2**

Please provide survey coordinates for points A and B on Figure 2.4-10.

**Response:**

Note that these points, A and B, represent only the approximate location of the discharges for drainage Basin A and Basin B, respectively. The approximate UTM coordinate (NAD 83) for point A is N3,543,936 and E683,868. The approximate coordinate for point B is N3,543,108 and E683,868.

**SSAR Section 2.4.6, Probable Maximum Tsunami Flooding**

**Request:**

**RAI 2.4.6-1**

Please document any seismically-induced tsunami-like waves near the site. Please include in this review the ability for a tsunami-like wave to impact the site.

**Response:**

There is no historical indication of landslides in the GGNS area caused by seismic activity, according to the Center for Earthquake Research and Information in Memphis. The Corps of Engineers also had no record of bluff failures or collapses in the GGNS site area.

According to the Corps of Engineers, the Mississippi coast is located in Tsunami Zone 1, with a predicted wave height of 5 feet. The site is located about river mile 406 above the Head of Passes and is not in a coastal region. No effects on water level in the Mississippi River due to geoseismic activity are expected to occur at this location. Conservatively assuming that a coastal tsunami wave reaches the Grand Gulf site without attenuation and coincident with the design project flood on the Mississippi River (102.1 ft), the maximum combined wave height elevation would be 107.1 ft. Therefore a facility located at an elevation of 132.5 ft. would not be affected.

References:

U.S. Army Corps of Engineers, Technical Instructions TI 809-04, Appendix F - Geologic Hazards Evaluation, December 31, 1998.

Personal communication (e-mail), Gary Patterson, Center for Earthquake Research and Information, Memphis, TN. August 10, 2004.

See file: 004_Personal Comm_Waves on MSR.pdf

## SSAR Section 2.4.9, Channel Diversions

### Request:

**RAI 2.4.9-1**

Please provide copies of references related to geological features or other characteristics that preclude any likelihood of channel diversion upstream of the site.

### Response:

From the GGNS UFSAR Section 2.4.1.2 [in italics]: "*Rivers of the Mississippi basin have numerous river-control structures ranging from levees and navigational locks to major dams. Details of these structures are described in subsection 2.4.4* [of the GGNS UFSAR]. *In the* [GGNS] *site region, the U. S. Army Corps of Engineers has built levees on the west bank with top elevations ranging from 101 to 103 ft.*" From the ESP Application SSAR Section 2.4.1.2: "The Corps of Engineers has completed revetments along the east and west river banks in the site area, including the east bank that borders the GGNS [and ESP] site, to maintain the river channel (Reference 1, and Figure 2.4-5). There are 1,610 miles of authorized levees on the main stem of the Mississippi River (Reference 2)."

From the SSAR Section 2.4.9: "In order to stabilize the river alignment, the Corps of Engineers has carried out extensive river control work in this area. This includes the construction of submerged dikes across the western channel to divert flow to the eastern channel and construction of the Grand Gulf revetments on the east bank from approximately river mile 400.5 to 407.9 and 408.2 to 410.0 (Reference 31).

"The Grand Gulf revetments in the two sections from approximately river mile 400.5 to 405.0 and 408.5 to 409.6 were completed in the 1960s and 1970s. The intervening section, which includes the river stretch near the GGNS site, was left unprotected to undergo erosion until it attained an acceptable alignment. The section on the east bank along the GGNS site boundary was completed in stages from the mid-1970s to the early 1980s, with a small gap at the existing GGNS barge slip (Reference 31). The upper banks are paved with riprap."

These features are intended to preclude any significant channel diversion in the Mississippi River upstream of the ESP site. In addition, as stated in response to RAI 2.4.1-4, the proposed facility draws water from the Mississippi River for the purposes of makeup and service water. The water use requirement for the proposed facility of 85,000 gpm is not used in safety analyses and is insignificant relative to available river flow. A channel diversion upstream of the proposed site of sufficient magnitude to impact the water use needs of the proposed facility would be a very remote possibility. Furthermore, even should such an extraordinary event occur, it would have no impact on systems, structures, and components important to safety for the new facility.

SSAR Reference 1: U. S. Army Corps of Engineers, Mississippi Valley Division, 1998 Flood Control and Navigation Maps – Mississippi River, 61st Edition, 1998

SSAR Reference 2: Mississippi River Commission, "State of the Lower Mississippi Valley," Report of Mississippi River Commission Public Meetings, April, 2001

SSAR Reference 31: U. S. Army Corps of Engineers, Vicksburg District, Mississippi River Hydrographic Survey 1995-1996, October 2001

## SSAR Section 2.4.11, Low Water Considerations

### Request:

#### RAI 2.4.11-1

Please describe how ice jams upstream from the site could (or could not) affect low water conditions at the site. Page 2.4-19 states that a minimum stage of 39.2 feet above MSL occurred on February 3,1940, when the river discharge was reduced by ice jams. What is the source of this stage data?

### Response:

Ice jams upstream from the ESP site could create low water conditions at the ESP site, as discussed in 2.4.11.2 of the ESP SSAR. A minimum stage at Vicksburg (39.2 feet msl) was reported when the discharge was reduced by ice jams upstream. This reduction in discharge by upstream ice jams is an infrequent occurrence.

Reference:

U. S. Army Corps of Engineers, Real-Time and Historical Data, URLs:

http://www2.mvr.usace.army.mil/WaterControl/stationinfo2.cfm?sid=CE40FF58&fid=VCKM6&dt=S

http://www2.mvr.usace.army.mil/WaterControl/stationrecords.cfm?sid=CE40FF58&dt=S

The Low Water Reference Plane for river mile 406 is 37.5 feet msl (USACE, 1998 Flood Control and Navigation Maps). The Low Water Reference Plane is based on the average stage from 1982-1991 representing the discharge equaled or exceeded 97 percent of the time (USACE, 1994 Flood Control and Navigation Maps). This data indicates that an intake structure as described in the SSAR would not have adverse effects from low water conditions due to ice jams or other causes.

**SSAR Section 2.4.12, Groundwater**

**Request:**

**RAI 2.4.12-1**

Please provide a description of the local subsurface environment adequate to understand groundwater pathways from the plant including subsurface disturbances of local strata from structures and perched aquifers.

**Response:**

Previous site investigations are detailed in the UFSAR, including extensive subsurface data obtained from borings. This data is also summarized in the ESP application. In addition, four borings were drilled as part of the ESP investigation, as detailed in section 2.5.4 of the ESP application. The conditions encountered during the ESP investigation (stratigraphy, material descriptions, and contacts) are consistent with those found during the UFSAR investigations. Direct groundwater measurements were not obtained during the ESP investigation; however, borehole seismic velocity P-S surveys were used to estimate the groundwater table location. The estimated groundwater table ranged between 70 and 100 feet below the ground surface, and corresponded to elevations between 55 and 63 ft msl.

As indicated in the response to RAI 2.4.1-1, additional detailed assessment to define the location and extent of perched aquifers would be conducted at COL when the plant design and location are finalized. From this information, a further assessment of potential groundwater pathways would be made.

## SSAR Section 2.4.13, Accidental Releases of Liquid Effluents in Ground and Surface Waters

### Request:

#### RAI 2.4.13-1

Please explain why Cs and Sr were selected in the analysis.

### Response:

As noted in SSAR Section 2.4.13, hydrogeological characteristics at the site relevant to the existing GGNS facility analysis on an accidental release of liquid effluents, have not changed in any significant way since the analysis was performed. Further, also as noted in that section, reviews to support the ESP application indicated that there are no downstream intakes within 100 miles of the GGNS site that use the Mississippi River as a potable water supply. However, as discussed with the NRC staff in the site visit of June 30, 2004, it is recognized that a more detailed assessment of groundwater at the ESP site and in particular, perched aquifers, would need to be performed at COL (as stated in RAI 2.4.1-1 above). The information gathered at COL would be used, in part, to determine if groundwater pathways have changed in any significant way that would impact the path of radionuclides from the site. The evaluation of accidental liquid releases would be re-evaluated at that time, considering the latest groundwater information. This evaluation would be performed considering the then current guidance and regulatory positions of NRC Regulatory Guide 1.113, as applicable.

## SSAR Section 3.1.6, Site Characteristics-Security Plans

### Request:

#### RAI 3.1.6-1

Please provide scale drawings that depict:

(a) The existing protected area (PA) boundary
(b) The existing vehicle checkpoint
(c) Proposed PA boundary for the power block structures and safety-related cooling towers
(d) The outer boundary of the owner controlled area (OCA)
(e) The shoreline of the river within the OCA
(f) All roads and railroads that penetrate the OCA
(g) The proposed location of the intake structure
(h) Existing culverts (greater than 254 square inches in cross-section area) that extend outside to inside the existing PA
(i) Existing and planned vehicle barrier systems
(j) Barge slips within the OCA
(k) Existing or planned culverts (greater than 254 square inches in cross-section area) that extend from outside to inside either the area for power blocks structures and/or the area for safety related cooling towers, and
(l) Grand Gulf Road, Bald Hill Road, Port Claiborne, nearby highway and proposed highway route(s) in relation to the OCA

### Response:

(a) There is no existing PA for the ESP site. The GGNS Unit 1 PA is shown on SSAR Figure 2.4-43. An approximation of its location is shown on the attached markup version of SSAR Figure 2.1-2.

See file: 005_2.1-2 PA MARKUP.pdf

(b) This is safeguards information for the existing Grand Gulf Nuclear Station, Docket No. 50-416. The information is contained in the GGNS Security Plan submitted by cover letter Reference 4.

(c) The PA boundary for the proposed facility is not yet defined, as the exact location of the facility is not known. However, it is expected that the power block location shown on SSAR Figure 2.1-2 (UTM grid coordinates shown, grid lines separation is 1000m) would be largely included within the ESP site PA.

(d) The outer boundary of the OCA is shown on SSAR Figure 2.1-1 as the site property line.

(e) The shoreline of the river in the OCA is shown on SSAR Figure 2.1-1 as the site property line along the river. See also ER Figure 2.1-2 which is a recent (2001) aerial photo with the site property line superimposed. A portion of the property has been consumed by the river as described in the ER. This aerial is not scaled.

(f) There are no railroads that penetrate the OCA. Bald Hill Road penetrates the OCA as shown on SSAR Figure 2.1-2, on the south side of the property. The south access road from Bald Hill Road near the Unit 1 cooling tower is currently blocked from traffic. Access to the site is from the north side of the property off Grand Gulf Road as shown on SSAR Figure 2.1-2, and on ER Figure 2.1-2. An access to the property is provided near the north end of Gin Lake as shown on these same two figures; this access is gated and can be closed if desired by Entergy. A small back-road to the south of Hamilton Lake which originates near Port Claiborne off Frank Headly Road also penetrates the site property boundary as seen in ER Figure 2.1-2.

(g) The proposed location of the intake is shown on SSAR Figure 2.1-2.

(h) There are none.

(i) This is safeguards information for the existing Grand Gulf Nuclear Station, Docket No. 50-416. The information is contained in the GGNS Security Plan submitted by cover letter Reference 4. Locations of vehicle barrier systems for the unit(s) proposed in the ESP application have not been determined and would be included as appropriate with a combined license application.

(j) The existing barge slip location is shown on SSAR Figure 2.1-2.

(k) There are currently none identified.

(l) There are no known proposed highway routes in the vicinity of the OCA. See files 002_Fig 2.1-5 Draft Rev1.PDF, 003_Figure2.1-5.tif, and 004_Figure2.1-5.DWG provided with cover letter Reference 5 for locations of other roads requested in this item. Port Claiborne is located at the end of Frank Headly Road as shown on ER Figure 2.1-1 (UTM coordinate grids shown) and ER Figure 2.1-2.