March 10, 2004

Mr. J. A. Scalice
Chief Nuclear Officer and
Executive Vice President
Tennessee Valley Authority
6A Lookout Place
1101 Market Street
Chattanooga, TN 37402-2801

SUBJECT: BROWNS FERRY NUCLEAR PLANT, UNITS 2 AND 3 — ISSUANCE OF AMENDMENTS REGARDING PRESSURE-TEMPERATURE LIMIT CURVES (TAC NOS. MC0807 AND MC0808)

Dear Mr. Scalice:

The Commission has issued the enclosed Amendment Nos. 288 and 247 to Facility Operating Licenses Nos. DPR-52 and DPR-68 for the Browns Ferry Nuclear Plant (BFN), Units 2 and 3, respectively. These amendments are in response to your application dated September 18, 2003, as supplemented by your letters of December 8, 2003, and February 24, 2004, which provided additional clarifying information. These amendments revise the pressure-temperature limit curves for BFN, Units 2 and 3.

A copy of the Safety Evaluation is also enclosed. Notice of Issuance will be included in the Commission's biweekly *Federal Register* notice.

Sincerely,

/RA/

Kahtan N. Jabbour, Senior Project Manager, Section 2
Project Directorate II
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket Nos. 50-260 and 50-296

Enclosures:
1. Amendment No. 288 to License No. DPR-52
2. Amendment No. 247 to License No. DPR-68
3. Safety Evaluation

cc w/enclosures: See next page

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TENNESSEE VALLEY AUTHORITY

DOCKET NO. 50-260

BROWNS FERRY NUCLEAR PLANT, UNIT 2

AMENDMENT TO FACILITY OPERATING LICENSE

Amendment No. 288
License No. DPR-52

1. The Nuclear Regulatory Commission (the Commission) has found that:

   A. The application for amendment by Tennessee Valley Authority (the licensee) dated September 18, 2003, as supplemented by your letters of December 8, 2003, and February 24, 2004, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's rules and regulations set forth in 10 CFR Chapter I;

   B. The facility will operate in conformity with the application, the provisions of the Act, and the rules and regulations of the Commission;

   C. There is reasonable assurance (i) that the activities authorized by this amendment can be conducted without endangering the health and safety of the public, and (ii) that such activities will be conducted in compliance with the Commission's regulations;

   D. The issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public; and

   E. The issuance of this amendment is in accordance with 10 CFR Part 51 of the Commission's regulations and all applicable requirements have been satisfied.

2. Accordingly, the license is amended by changes to the Technical Specifications as indicated in the attachment to this license amendment and paragraph 2.C.(2) of Facility Operating License No. DPR-52 is hereby amended to read as follows:

   (2) Technical Specifications

   The Technical Specifications contained in Appendices A and B, as revised through Amendment No. 288, are hereby incorporated in the license. The licensee shall operate the facility in accordance with the Technical Specifications.

3. This license amendment is effective as of its date of issuance and shall be implemented within 30 days from the date of issuance.

FOR THE NUCLEAR REGULATORY COMMISSION

/RA/

William F. Burton, Acting Chief, Section 2
Project Directorate II
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Attachment: Changes to the Technical Specifications

Date of Issuance: March 10, 2004

ATTACHMENT TO LICENSE AMENDMENT NO. 288

FACILITY OPERATING LICENSE NO. DPR-52

DOCKET NO. 50-260

Replace the following pages of the Appendix A Technical Specifications with the attached revised pages. The revised pages are identified by amendment number and contain marginal lines indicating the areas of change.

REMOVE	INSERT
3.4-26	3.4-26
3.4-28	3.4-28
3.4-29	3.4-29
---------	3.4-29a
---------	3.4-29b
---------	3.4-29c

TENNESSEE VALLEY AUTHORITY

DOCKET NO. 50-296

BROWNS FERRY NUCLEAR PLANT, UNIT 3

AMENDMENT TO FACILITY OPERATING LICENSE

Amendment No. 247
License No. DPR-68

1. The Nuclear Regulatory Commission (the Commission) has found that:

   A. The application for amendment by Tennessee Valley Authority (the licensee) dated September 18, 2003, as supplemented by your letters of December 8, 2003, and February 24, 2004, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's rules and regulations set forth in 10 CFR Chapter I;

   B. The facility will operate in conformity with the application, the provisions of the Act, and the rules and regulations of the Commission;

   C. There is reasonable assurance (i) that the activities authorized by this amendment can be conducted without endangering the health and safety of the public, and (ii) that such activities will be conducted in compliance with the Commission's regulations;

   D. The issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public; and

   E. The issuance of this amendment is in accordance with 10 CFR Part 51 of the Commission's regulations and all applicable requirements have been satisfied.

2. Accordingly, the license is amended by changes to the Technical Specifications as indicated in the attachment to this license amendment and paragraph 2.C.(2) of Facility Operating License No. DPR-68 is hereby amended to read as follows:

   (2) Technical Specifications

   The Technical Specifications contained in Appendices A and B, as revised through Amendment No. 247, are hereby incorporated in the license. The licensee shall operate the facility in accordance with the Technical Specifications.

3. This license amendment is effective as of its date of issuance and shall be implemented within 30 days from the date of issuance.

FOR THE NUCLEAR REGULATORY COMMISSION

/RA/

William F. Burton, Acting Chief, Section 2
Project Directorate II
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Attachment: Changes to the Technical Specifications

Date of Issuance: March 10, 2004

ATTACHMENT TO LICENSE AMENDMENT NO. 247

FACILITY OPERATING LICENSE NO. DPR-68

DOCKET NO. 50-296

Replace the following pages of the Appendix A Technical Specifications with the attached revised pages. The revised pages are identified by amendment number and contain marginal lines indicating the areas of change.

REMOVE	INSERT
3.4-26	3.4-26
3.4-28	3.4-28
3.4-29	3.4-29
--------	3.4-29a
--------	3.4-29b
--------	3.4-29c

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO AMENDMENT NO. 288 TO FACILITY OPERATING LICENSE NO. DPR-52

AND AMENDMENT NO. 247 TO FACILITY OPERATING LICENSE NO. DPR-68

TENNESSEE VALLEY AUTHORITY

BROWNS FERRY NUCLEAR PLANT, UNITS 2 AND 3

DOCKET NOS. 50-260 AND 50-296

1.0 INTRODUCTION

By letter dated September 18, 2003 (Reference 1), as supplemented by letters of December 8, 2003, and February 24, 2004 (References 2 and 3), the Tennessee Valley Authority (TVA or the licensee) submitted a request for changes to the Browns Ferry Nuclear Plant (BFN), Units 2 and 3, Technical Specifications (TSs) to update the reactor pressure vessel (RPV) pressure-temperature (P-T) limit curves. The proposed update would revise the P-T curves for Unit 2 to 23 and 30 effective full-power years (EFPYs) of operation and for Unit 3 to 20 and 28 EFPYs. The current limits are 17.2 and 13.1 for Units 2 and 3, respectively. In the February 24, 2004, letter, the licensee stated that both sets of P-T curves will be placed into the TSs upon U.S. Nuclear Regulatory Commission (NRC) approval. The December 8, 2003, and February 24, 2004, letters provided clarifying information that did not change the scope of the original request or the initial proposed no significant hazards consideration determination.

2.0 EVALUATION

2.1 P-T LIMITS

2.1.1 REGULATORY EVALUATION

The NRC has established requirements in Title 10, *Code of Federal Regulations (*10 CFR) Part 50 to protect the integrity of the reactor coolant pressure boundary in nuclear power plants. The staff evaluates the P-T limit curves based on the following NRC regulations and guidance: Appendix G to 10 CFR Part 50; Generic Letter (GL) 88-11; GL 92-01, Revision (Rev.) 1; GL 92-01, Rev. 1, Supplement 1 and Standard Review Plan (SRP) Section 5.3.2. Appendix G to 10 CFR Part 50 requires that P-T limit curves for the RPV be at least as conservative as those obtained by applying the methodology of Appendix G to Section XI American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code). GL 88-11 advised licensees that the NRC staff would use Regulatory Guide (RG) 1.99, Rev. 2, to review P-T limit curves. RG 1.99, Rev. 2, contains methodologies for determining the increase in transition temperature and the decrease in upper-shelf energy resulting from neutron radiation. GL 92-01, Rev. 1, requested that licensees submit their RPV data for their plants to the NRC staff for review. GL 92-01, Rev. 1, Supplement 1, requested that licensees provide and assess data from other licensees that could affect their RPV integrity evaluations. These data are used by the NRC staff as the basis for the review of P-T limit curves. SRP Section 5.3.2 provides an acceptable method of determining the P-T limit curves for ferritic materials in the beltline of the RPV based on the linear elastic fracture mechanics methodology of Appendix G to Section XI of the ASME Code.

The basic parameter of the methodology specified in Appendix G to Section XI of the ASME Code is the stress intensity factor K_I, which is a function of the stress state and flaw configuration. Appendix G requires a safety factor of 2.0 on stress intensities resulting from reactor pressure during normal and transient operating conditions, and a safety factor of 1.5 for hydrostatic testing curves. Appendix G to Section XI of the ASME Code also requires a safety factor of 1.0 on stress intensities resulting from thermal loads for normal and transient operating conditions as well as for hydrostatic testing. The methods of Appendix G postulate the existence of a sharp surface flaw in the RPV that is normal to the direction of the maximum stress. This flaw is postulated to have a depth that is equal to 1/4 of the RPV beltline thickness and a length equal to 1.5 times the RPV beltline thickness. The critical locations in the RPV beltline region for calculating heatup and cooldown P-T curves are the 1/4 thickness (1/4T) and 3/4 thickness (3/4T) locations, which correspond to the maximum depth of the postulated inside surface and outside surface defects, respectively.

The Appendix G ASME Code methodology requires that licensees determine the adjusted reference temperature (ART or adjusted RT_{NDT}) at 1/4T and 3/4T locations. The ART is defined as the sum of the initial (unirradiated) reference temperature (initial RT_{NDT}), the mean value of the adjustment in reference temperature caused by irradiation (ΔRT_{NDT}), and a margin (M) term. The ΔRT_{NDT} is a product of a chemistry factor and a fluence factor. The chemistry factor is dependent upon the amount of copper and nickel in the material and may be determined from the tables in RG 1.99, Rev. 2, or from surveillance data. The fluence factor is dependent upon the neutron fluence at the maximum postulated flaw depth. The margin term is dependent upon whether the initial RT_{NDT} is a plant-specific or a generic value and whether the chemistry factor was determined using the tables in RG 1.99, Rev. 2, or surveillance data. The margin term is used to account for uncertainties in the values of the initial RT_{NDT}, the copper and nickel contents, the fluence and the calculational procedures. RG 1.99, Rev. 2, describes the methodology to be used in calculating the margin term.

2.1.2 TECHNICAL EVALUATION

2.1.2.1 Licensee Evaluation

Pursuant to 10 CFR 50.90, the licensee submitted a request to the NRC staff for the approval of Technical Specification changes indicating the revised RPV P-T limit curves for both units. The proposed P-T curves were developed in accordance with 10 CFR Part 50 Appendix G and Section XI ASME Code 1998 Edition, 2000 Addenda which incorporates ASME Code Cases N-588 and N-640 as the basis for establishing the P-T limit curves. Code Case N-588 allows the usage of circumferentially oriented postulated defects in circumferential welds (reference paragraph G-2120 of Appendix G of ASME Section XI). Code Case N-640 permits application of the lower bound static initiation fracture toughness value equation (K_{IC} equation) as the basis for establishing the P-T curves in lieu of using the lower bound crack arrest fracture toughness value equation (i.e., the K_{IA} equation, which is based on conditions needed to arrest a dynamically propagating crack, and which is the method invoked prior to 1998 editions of Appendix G to Section XI of the ASME Code). Paragraph G-2110 of Appendix G of ASME Section XI describes the usage of Code Case N-640.

The P-T limits apply for both heatup/cooldown and for both 1/4T and 3/4T locations because the maximum tensile stresses for either heatup or cooldown is applied at the 1/4T location. For the beltline curves this approach has added conservatism because irradiation effects cause the allowable K_{IC} at 1/4T to be less than at the 3/4T for a given temperature. As a result, the 1/4T location is limiting at all temperatures.

The licensee submitted ART calculations and P-T limit curves valid for up to 23 and 30 EFPY for BFN Unit 2, and 20 and 28 EFPY for BFN Unit 3. For the reactor vessels of these units, the licensee determined that the most limiting material at the 1/4T and 3/4T locations is the lower intermediate shell plate axial welds (heat ESW [electroslag welding]). The ART value, the neutron fluence and the ΔRT_{NDT} values at the 1/4T location of the limiting axial weld for both units are given below:

Unit	EFPY	Neutron Fluence (n/cm^2)	ΔRT_{NDT} (^{0} F)	ART (^{0} F)
2	23	7×10^{17}	49	128
2	30	9.2×10^{17}	56	141
3	20	6.1×10^{17}	46	122
3	28	8.6×10^{17}	54	138

2.1.2.2 Staff Evaluation

TVA's proposed revision to the P-T limits is necessary due to their planned 20 percent power uprate which will commence at 18.1 EFPY for Unit 2 and 13.0 EFPY for Unit 3. The licensee's calculated fluence values are applicable for 23 EFPY and 30 EFPY for Unit 2 and 20 EFPY and 28 EFPY for Unit 3. In the February 24, 2004, letter, the licensee stated that both sets of P-T curves will be placed into the TSs upon NRC approval. The applicability of each set is clearly indicated. The staff finds this process acceptable.

Appendix G to 10 CFR Part 50 requires the use of ASME Code Section XI, Appendix G and defines the acceptable Editions and Addenda of the Code which is endorsed in 10 CFR 50.55a. The 2003 Edition of 10 CFR Part 50.55a endorses Editions and Addenda of ASME Section XI up through the 1998 Edition and 2000 Addenda. The provisions of Code Cases N-588 and N-640 have been directly incorporated into the 2000 Addenda of ASME Section XI, Appendix G. The NRC staff has reviewed the licensee's methodology of establishing the P-T curve limits using 2000 Addenda of ASME Section XI, Appendix G, and finds it acceptable.

The NRC staff performed an independent calculation of the ART values for the limiting material using the methodology in RG 1.99, Rev. 2. Based on these calculations, the NRC staff verified that the licensee's limiting material for the TVA reactor vessels is the lower intermediate shell plate axial welds (heat ESW). The NRC staff's calculated ART values for the limiting material agreed with the licensee's calculated ART values.

The NRC staff evaluated the licensee's P-T limit curves for the beltline region by performing independent calculations using the methodology referenced in the ASME Boiler and Pressure Vessel Code (as indicated by SRP 5.3.2), and verified that the licensee's proposed P-T curve limits satisfy the requirements in Paragraph IV.A.2 of 10 CFR Part 50, Appendix G. The licensee has clarified in a supplemental letter dated December 8, 2003, that a most conservative value of stress intensity factor (K_t) due to thermal gradient was used at 1/4T location of the vessel wall for cooldown rates of 100 °F/hr at various pressures for establishing the P-T limit curves for the beltline region. The NRC staff agrees that this methodology will provide adequate safety margins for the beltline P-T limit curves. In addition, the NRC staff independently generated P-T limit curves for normal operations and hydrostatic test pressures effective to the specified EFPYs for TVA. By comparing the independently generated P-T curves with the licensee's curves, the NRC staff determined that the licensee's proposed P-T limit curves meet the requirements of Appendix G of Section XI of the ASME Code, 1998 Edition, 2000 Addenda. Therefore, the NRC staff determined that the licensee's proposed P-T limit curves are acceptable.

In addition to beltline materials, Appendix G of 10 CFR Part 50 also imposes a minimum temperature at the closure head flange based on the reference temperature for the flange material. Section IV.A.2 of Appendix G states that when the pressure exceeds 20 percent of the preservice system hydrostatic test pressure, the temperature of the closure flange regions (highly stressed by the bolt preload) must exceed the reference temperature of the material in those regions by at least 120 °F for normal operation and by 90 °F for hydrostatic pressure tests and leak tests. The NRC staff has determined that the proposed P-T limits have satisfied the requirement for the closure flange region during normal operation and inservice leak and hydrostatic testing.

The NRC staff has reviewed the licensee's method of establishing the bolt-up temperature using the limiting initial RT_{NDT} for the closure flange region + 60 °F or the Lowest Service Temperature (LST) of the bolting materials, whichever is greater. The limiting initial RT_{NDT} for the closure flange region is 23.1 °F, which is represented by the electroslag weld materials in the lower intermediate shell plate axial welds. The LST of the closure studs is 70 °F. Therefore, the bolt-up temperature of 83 °F (60 + 23) is acceptable.

The P-T limit curves for the non-beltline region (upper vessel and bottom head) were conservatively developed for a BWR/6 with nominal inside diameter of 251 inches. The analysis is considered appropriate for TVA since the plant specific geometric values are bounded by the generic analysis for large BWR/6. The generic value was adapted to the conditions at TVA using plant specific RT_{NDT} values for the reactor pressure vessel. The NRC staff finds the application of the generic BWR/6 analysis to the non-beltline region P-T curves at the TVA facility acceptable. The licensee has clarified in a supplemental letter dated December 8, 2003, that the value of the membrane stress intensity factor for an inside axial postulated surface flaw was based on the thickness of the blend radius at the intersection of the nozzle and the vessel wall. The NRC staff agrees with this conservative approach in establishing P-T curve limits for the feedwater nozzle in the upper vessel region.

2.1.3 SUMMARY

The NRC staff concludes that the proposed P-T limits curves for each of the pressure tests (core not critical and core critical conditions), and the separate P-T curves for the upper vessel, beltline, and bottom head satisfy the requirements in Appendix G of 10 CFR 50. Based on the information provided in the licensee's submittal, the proposed P-T limit curves may be incorporated into the BFN TSs.

2.2 FLUENCE

2.2.1 Estimated Pressure Vessel Fluence to the End of the Current License

Unit 2 will begin operation at the uprated power level of 3952 megawatt thermal (MWt) at 18.1 EFPYs. The total power uprate amounts to 20 percent. The peak vessel flux was calculated using the General Electric (GE), NRC staff-approved, methodology (Reference 4) at the uprated power for the entire operating life of the plant. Unit 2 is estimated to operate to 30 EFPYs. The licensee calculated peak vessel fluence at 23 EFPYs using the peak flux and operating time (Enclosure 5 of Reference 2). In both instances 1/4T and 3/4T values were calculated using the method in RG 1.99, Revision 2. Because the NRC staff-approved methods with conservative assumptions were used, the NRC staff finds the Unit 2 fluence calculations acceptable. Unit 3 will begin operation at the power uprated level of 3952 MWt at about 13.0 EFPYs. The total power uprate amounts to 20 percent. The peak vessel flux was calculated using the NRC staff approved GE methodology (Reference 3) at the uprated power for the entire operating life of the plant. Unit 3 is estimated to operate to 28 EFPYs. The licensee calculated peak vessel fluence at 20 EFPYs using the peak flux and operating time (Enclosure 6 of Reference 2). In both instances 1/4T and 3/4T values were calculated using the method in RG 1.99, Revision 2. Because the NRC staff-approved methods with conservative assumptions were used, the NRC staff finds the Unit 3 fluence calculations acceptable.

2.2.2 Technical Specification Changes

The proposed changes would revise TS 3.4.9 “Pressure Temperature Limits,” including Figure 3.4.9-1 for BFN Units 2 and 3. In addition, TS Figure 3.4.9-2 was added for both units. The two sets of Figures correctly represent the period of applicability and, therefore, are acceptable.

2.2.3 SUMMARY

The licensee proposed to revise the reactor vessel P-T limit curves in TS Figure 3.4.9-1 and to add Figure 3.4.9-2 for each unit. The revised P-T limits are calculated using staff-approved methods and, therefore, are acceptable.

3.0 STATE CONSULTATION

In accordance with the Commission's regulations, the Alabama State official was notified of the proposed issuance of the amendment. The State official had no comments.

4.0 ENVIRONMENTAL CONSIDERATION

The amendments change a requirement with respect to installation or use of a facility component located within the restricted area as defined in 10 CFR Part 20. The NRC staff has determined that the amendments involve no significant increase in the amounts, and no significant change in the types, of any effluents that may be released offsite, and that there is no significant increase in individual or cumulative occupational radiation exposure. The Commission has previously issued a proposed finding that the amendments involve no significant hazards consideration, and there has been no public comment on such finding (68 FR 61480). Accordingly, the amendments meet the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9). Pursuant to 10 CFR 51.22(b) no environmental impact statement or environmental assessment need be prepared in connection with the issuance of the amendments.

5.0 CONCLUSION

The Commission has concluded, based on the considerations discussed above, that: (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, (2) such activities will be conducted in compliance with the Commission's regulations, and (3) the issuance of the amendments will not be inimical to the common defense and security or to the health and safety of the public.

6.0 REFERENCES

1. Letter from T. E. Abney Tennessee Valley Authority to NRC "Browns Ferry Nuclear Plant (BFN) - Units 2 and 3 - Technical Specifications (TS) Change No. 414 Revision 1 - Update of Pressure-Temperature (P-T) Curves," September 18, 2003.

2. Letter from T. E. Abney Tennessee Valley Authority to NRC "Browns Ferry Nuclear Plant (BFN) - Units 2 and 3 - Technical Specifications (TS) Change No. 414 Revision 1 - Update of Pressure-Temperature (P-T) Curves, "December 8, 2003.

3. Letter from T. E. Abney Tennessee Valley Authority to NRC "Browns Ferry Nuclear Plant (BFN) - Units 2 and 3 - Technical Specifications (TS) Change No. 414 Revision 1 - Update of Pressure-Temperature (P-T) Curves," February 24, 2004.

4. NEDC-32983P-A Revision 1, "General Electric Methodology for Reactor Pressure Vessel Fast Neutron Flux Evaluations," by S. Sitaraman, S. Wang and T. Wu, GE, December 2001.

Principal Contributors: Lambros Lois
Ganesh Cheruvenki

Date: March 10, 2004

cc:

Mr. Karl W. Singer, Senior Vice President
Nuclear Operations
Tennessee Valley Authority
6A Lookout Place
1101 Market Street
Chattanooga, TN 37402-2801

Mr. James E. Maddox, Vice President
Engineering & Technical Services
Tennessee Valley Authority
6A Lookout Place
1101 Market Street
Chattanooga, TN 37402-2801

Mr. Ashok S. Bhatnagar, Site Vice President
Browns Ferry Nuclear Plant
Tennessee Valley Authority
P.O. Box 2000
Decatur, AL 35609

General Counsel
Tennessee Valley Authority
ET 11A
400 West Summit Hill Drive
Knoxville, TN 37902

Mr. T. J. Niessen, Acting General Manager
Nuclear Assurance
Tennessee Valley Authority
6A Lookout Place
1101 Market Street
Chattanooga, TN 37402-2801

Mr. Michael D. Skaggs, Plant Manager
Browns Ferry Nuclear Plant
Tennessee Valley Authority
P.O. Box 2000
Decatur, AL 35609

Mr. Jon R. Rupert, Vice President
Browns Ferry Unit 1 Restart
Browns Ferry Nuclear Plant
Tennessee Valley Authority
P.O. Box 2000
Decatur, AL 35609

Mr. Robert G. Jones
Browns Ferry Unit 1 Plant Restart Manager
Browns Ferry Nuclear Plant
Tennessee Valley Authority
P.O. Box 2000
Decatur, AL 35609

Mr. Mark J. Burzynski, Manager
Nuclear Licensing
Tennessee Valley Authority
4X Blue Ridge
1101 Market Street
Chattanooga, TN 37402-2801

Mr. Timothy E. Abney, Manager
Licensing and Industry Affairs
Browns Ferry Nuclear Plant
Tennessee Valley Authority
P.O. Box 2000
Decatur, AL 35609

Senior Resident Inspector
U.S. Nuclear Regulatory Commission
Browns Ferry Nuclear Plant
10833 Shaw Road
Athens, AL 35611

State Health Officer
Alabama Dept. of Public Health
RSA Tower - Administration
Suite 1552
P.O. Box 303017
Montgomery, AL 36130-3017

Chairman
Limestone County Commission
310 West Washington Street
Athens, AL 35611