UNITED STATES DISTRICT COURT
EASTERN DISTRICT OF TENNESSEE
AT KNOXVILLE

NATIONAL PARKS CONSERVATION ASSOCIATION, INC., SIERRA CLUB, INC., and OUR CHILDREN'S EARTH FOUNDATION,	)	
Plaintiffs,	)	
v.	)	No.: 3:01-CV-71 (VARLAN/GUYTON)
TENNESSEE VALLEY AUTHORITY,	)	
Defendant.	)	

OPINION

This matter is before the Court following a bench trial on plaintiffs' claims that defendant violated the federal Clean Air Act (the "CAA"), codified at 42 U.S.C. §§ 7401-7671q, and the Tennessee State Implementation Plan (the "SIP"), codified at 40 C.F.R. §§ 52.2220, *et seq.* [Doc. 80, ¶¶ 41-47], in connection with defendant's operation of the Bull Run power plant ("Bull Run"), a fossil fuel-fired electricity generating facility located in Clinton, Tennessee. Plaintiffs are the National Parks Conservation Association, Inc. (the "NPCA"), the Sierra Club, Inc. (the "Sierra Club"), and Our Children's Earth Foundation ("OCE") [*Id.*, ¶¶ 6-10]. Defendant is the Tennessee Valley Authority ("TVA"), a corporate agency and instrumentality of the United States [*Id.*, ¶ 13]. TVA owns and operates Bull Run [*Id.*].

This Court has subject matter jurisdiction over the claims in this case pursuant to 42 U.S.C. § 7604(a), the citizen suit provision of the CAA, and 28 U.S.C. § 1331, the federal question statute. Jurisdiction also exists under § 1331 because alleged violations of a federally-approved state air pollution program are federally remediable. *Gen. Motors Corp. v. United States*, 496 U.S. 530, 533-34 (1990); *United States v. Ford Motor Co.*, 814 F.2d 1099, 1102 (6th Cir. 1987). The relief requested is authorized pursuant to 42 U.S.C. § 7604 and 28 U.S.C. §§ 2201 and 2202. Venue lies in the Eastern District of Tennessee pursuant to 42 U.S.C. § 7604(c) and 28 U.S.C. §§ 1391(b) and (c) because Bull Run is located in Anderson County, Tennessee.

After careful consideration of all of the evidence presented at trial, as well as the law applicable to this case, the Court will enter judgment for TVA. In doing so, the Court first presents the issues which were to be determined at trial. It then resolves several evidentiary matters taken under advisement during the course of the trial. Finally, and pursuant to Federal Rule of Civil Procedure 52(a), the Court makes findings of fact and conclusions of law based on the evidence adduced at trial.

I. Issues

The parties agree that the issues to be resolved during the bench trial were:

(1) Whether the 1988 project at Bull Run replacing the economizer elements caused significant net emissions increases in sulfur dioxide or nitrogen oxides;

(2) Whether the 1988 project at Bull Run replacing the inlet portion of the secondary superheater outlet pendant elements caused significant net emissions increases in sulfur dioxide or nitrogen oxides;

(3) Whether the 1988 project at Bull Run replacing the economizer elements was routine maintenance, repair, and replacement;[1] and

(4) Whether the 1988 project at Bull Run replacing the inlet portion of the secondary superheater outlet pendant elements was routine maintenance, repair, and replacement.

[Doc. 185, ¶ 5]. TVA has also raised a "fair notice" issue. TVA characterizes the sub-issues to be resolved with respect to this issue as follows:

(1) Whether TVA had fair notice in 1988 of the standards now being used to determine whether maintenance, repair, and replacement projects were "routine"; and

(2) Whether TVA had fair notice in 1988 of the standards now being used to determine whether a project "would result in" a "significant net emissions increase."

[Doc. 195]. Plaintiffs characterize this issue instead as, to the extent a fair notice defense is available to TVA, whether TVA received fair notice of the violations alleged in this case [*Id.*]. Because the Court does not reach the fair notice issue, it need not determine which framing of the issue is appropriate.

For the reasons below, this Court finds that the projects at issue in this case are properly categorized as routine maintenance, repair, and replacement. Before making its findings of fact and conclusions of law, however, the Court resolves several evidentiary matters taken under advisement during the course of the trial.

---

[1] The Court periodically refers to "routine maintenance, repair, and replacement" using the shorthand "RMRR."

II. Evidentiary Matters

The Court reserved rulings on four evidentiary matters at trial. It considers these matters below.

A. Plaintiffs' Objections to TVA's Exhibit 148 (Excerpts of Deposition Testimony of Barry Stephens)

TVA provided timely notice of its intention to rely upon excerpts from the deposition of Barry Stephens, the Director of the Division of Air Pollution Control for the State of Tennessee [Doc. 178; Doc. 178-4, at 6].[2] TVA moved for introduction of those excerpts at trial as Defendant's Exhibit 148 [Doc. 208, at 194-95]. Plaintiffs objected to the introduction of certain portions of those deposition excerpts [Doc. 193]. Plaintiffs argued that the objected-to portions (1) lacked sufficient foundation, and (2) are improper opinion evidence [Doc. 193, at 5-6]. The Court admitted the unobjected-to portions of Mr. Stephens's deposition, and took under advisement the objected-to portions of the deposition testimony [Doc. 208, at 194-95].

Plaintiffs first argue that these portions lack sufficient foundation because "Mr. Stephens admitted at the outset of his deposition that he has 'no actual information that [he] reviewed concerning the specific case'" [Doc. 193, at 6; Doc. 178-4, at 17]. Plaintiffs object to Mr. Stephens's deposition testimony that the projects at issue in this case "involved retubing in an economizer and retubing in a superheater section of . . . the furnace . . . at Bull

[2] Unless otherwise indicated, page numbers of documents and exhibits are to the PDF page number rather than to the document's internal page number.

Run"; that the cost for the projects was "about 8 million dollars"; and that the cost "was a very insignificant amount of money compared to the cost of building the plant to begin with" [Doc. 178-4, at 19-21]. Plaintiffs contend that this testimony, lacking in foundation, is inadmissible [Doc. 193, at 6].

TVA responds that plaintiffs have already stipulated to the accuracy of the objected-to testimony [Doc. 205, at 3].[3] TVA responds further that witnesses for both plaintiffs and defendant have established the accuracy of these facts [Doc. 212-1, at 12]. TVA responds finally that the deposition testimony of Mr. Stephens has not been offered as independent verification of these facts, but rather as a basis for statements he made about the projects [Doc. 212-1, at 12].

The Court will strike this deposition testimony. As noted, Mr. Stephens represented in his deposition that he had "no actual information that [he] reviewed" with respect to this case [Doc. 178-4, at 17]. Instead, "[i]t was communicated to [him] what types of projects we were talking about" [Doc. 178-4, at 17]. He repeatedly indicated that he was "told" about the basic features of the 1988 projects, but otherwise had no direct knowledge of them [Doc. 178-4, at 17-19, 21]. In light of Mr. Stephens's lack of direct knowledge of these projects, and in light of the stipulation of the parties to the cost of the projects, Mr. Stephens's

[3] *See* Doc. 185, ¶¶ 48, 53, 60 ("In 1988 all the economizer elements in both the A and B furnaces at Bull Run were replaced . . . The cost of the 1988 economizer replacement was $6,456,599.14 in 1988 dollars . . . The cost of the partial superheater replacement project was $1,846,680.59 in 1988 dollars.").

speculative deposition testimony relating to the underlying facts of the projects will be stricken from the record. Plaintiffs' objection as to this testimony will be sustained.

Second, plaintiffs argue that all of the "opinion" testimony in Mr. Stephens's deposition should be excluded from consideration by the Court because such testimony constitutes inadmissible legal conclusions in spite of the fact that Mr. Stephens "has not been disclosed as an expert in this case and has not submitted an expert report" [Doc. 193, at 6]. Plaintiffs object in particular to Mr. Stephens's stated opinions regarding the extent of work performed at Bull Run and his opinions regarding the Environmental Protection Agency's (the "EPA's") interpretation and application of its regulations regarding the work at Bull Run [Doc. 193, at 6].

TVA responds that Mr. Stephens's testimony does not constitute inadmissible legal testimony [Doc. 205, at 3]. TVA responds further that TVA neither compensated Mr. Stephens for providing testimony, nor retained him as an expert witness [Doc. 212-1, at 13 n.10]. Assuming the Court finds Mr. Stephens to be an expert witness, TVA also provides several case citations upholding the use of expert testimony in providing legal conclusions in limited circumstances [Doc. 205, at 3-5].

The Court finds that even if Mr. Stephens's deposition testimony regarding the extent of the work performed at Bull Run and the EPA's interpretation and application of its regulations regarding the work at Bull Run constitutes expert testimony, it will nevertheless be admitted. TVA provided notice of Mr. Stephens's expected testimony, along with a written summary of that testimony, at the same time it provided its expert disclosures to plaintiffs [Doc. 205, at 2]. Moreover, in his deposition, Mr. Stephens outlined his (1) thirty-four years of experience at the Tennessee Department of Environment and Conservation ("TDEC"); his (2) experience as the person at TDEC who wrote the applicable TDEC prevention of significant deterioration of air quality ("PSD") regulations; and (3) his present position as the highest-ranking state official in charge of air quality and implementation of the Tennessee Air Quality Act and the CAA [Doc. 178-4, at 6-11]. This Court heeds the Sixth Circuit's suggestion that "a court should not hesitate to seek out all of the practical assistance it can obtain in its function as ultimate determiner of the law," particularly where, as here, "the legal inquiry extends to a complex scheme." *In re Madeline Marie Nursing Homes*, 694 F.2d 433, 445 (6th Cir. 1982).

The Court notes further that expert witnesses are permitted to opine on a legal conclusion as long as their testimony would not determine an ultimate issue before the factfinder. *See United States v. Monus*, 128 F.3d 376, 386 (6th Cir. 1997) (legal opinion admissible where opinion does not instruct the factfinder on controlling legal principles). Also, as the Court noted in its memorandum opinion and order on summary judgment, "the interpretation of Mr. Stephens is not necessarily dispositive" [Doc. 170, at 31]. *See also Envtl. Def. v. Duke Energy Corp.*, 549 U.S. 561, 580-81 (2007) ("[A]n isolated opinion of an agency official does not authorize a court to read a regulation inconsistently with its language."). Admission of testimony as to the proper interpretation of PSD regulations by the author of those regulations is therefore in line with the Sixth Circuit's admonition above. Plaintiffs' objection as to this testimony will be overruled.

B. TVA's Objections to Plaintiffs' Exhibit 3 (TVA's Interrogatory Responses)

On the last day of trial, plaintiffs sought to move into evidence TVA's responses to interrogatories propounded by plaintiffs [Doc. 209, at 13-14]. The Court admitted these responses as Plaintiffs' Exhibit 237, subject to objections by counsel for TVA during cross-examination [Doc. 209, at 14]. Plaintiffs ultimately identified interrogatories 6, 7, 8, 9, 15, and 16 as those that they moved into evidence [Doc. 209, at 47]. TVA raised no objection to the admission of interrogatories 6, 7, 8, and 9 [Doc. 212-1, at 15]. The Court thus admits those interrogatory responses.

Interrogatory 15 requested that TVA provide "the potential to emit [sulfur dioxide] in tons per year, for the Bull Run coal-fired boiler as of February of 1988" [P.'s Ex. 3, at 11]. Similarly, Interrogatory 16 requested that TVA provide "the potential to emit [nitrogen oxides] in tons per year, for the Bull Run coal-fired boiler as of February of 1988" [P.'s Ex. 3, at 12]. TVA provided the requested information, but objected to both interrogatories as follows:

> TVA objects to providing information regarding "potential to emit" because it is not relevant to any party's claim or defense, and thus is not discoverable. Fed. R. Civ. P. 26(b)(1). In particular, the Federal Courts have clearly rejected applicability of an "actual-to-potential" test for units like the Bull Run plant which have begun normal operations. *See, e.g.*, *Wis. Elec. Power Co. v. Reilly*, 893 F.2d 901, 915-18 (7th Cir. 1990).

[P.'s Ex. 3, at 12-13]. TVA requests that these responses be excluded because they relate only to the actual-to-potential test, which this Court, on multiple occasions before and during trial, expressed reluctance in applying.[4]

The Court sustains TVA's relevance objection, and excludes the responses to interrogatories 15 and 16. After again reviewing the relevant case law and the arguments of the parties, the Court finds no compelling legal basis for the "actual-to-potential" methodology propounded by plaintiffs. The Court thus excludes as irrelevant TVA's responses to interrogatories 15 and 16.

C. TVA's Objections to Robert Koppe's Emissions Calculations Using the 1984-86 Baseline Period

At trial, plaintiffs' expert, Robert Koppe, presented emissions projections for the 1984-86 baseline that he had not disclosed as part of his expert report [Doc. 204, at 49-52]. TVA objected to this testimony, arguing that its presentation at trial violated Federal Rules of Civil Procedure 26 and 37 [Doc. 204, at 49-52]. The Court permitted Mr. Koppe to present the projections subject to TVA's objection.

Federal Rule of Civil Procedure 26(a)(2)(B)(i) provides that an expert witness's report must contain "a complete statement of all opinions the witness will express and the basis and reasons for them." "If a party fails to provide information . . . as required by Rule 26(a) . .

[4] *See, e.g.*, Doc. 170 at 27 ("[T]he Court is reluctant to apply the actual-to-potential to emit test."); Doc. 209, at 51 ("[A]t the summary judgment stage the Court . . . certainly expressed a reluctance, if not a strong reluctance, to apply the actual to potential test. So the Court . . . plan[s] to apply the actual to projected actual . . . test unless . . . the Plaintiffs–could show me a strong reason why I shouldn't.").

. the party is not allowed to use that information or witness to supply evidence . . . at a trial, unless that failure was substantially justified or is harmless." Fed. R. Civ. P. 37(c)(1). TVA contends that plaintiffs violated Rule 26 by failing to disclose any actual-to-projected-actual emissions calculations using the 1984-86 baseline period in any expert report or supplement, and violated Rule 37 by failing to demonstrate that non-disclosure was either substantially justified or harmless.

The Court is not convinced that the plaintiffs violated Rule 26 in this instance. As counsel for plaintiffs noted at trial, Mr. Koppe used the 1984-86 baseline and a slightly different emissions test in making calculations in his rebuttal report [Doc. 204, at 50]. Counsel noted further that "[a]ll of th[is] information was made available to TVA long ago in terms of the methodology, the rate, [and] the amount of emissions that [Mr. Koppe] actually calculated" [Doc. 204, at 50]. Moreover, TVA's expert was present during this testimony to observe and rebut these calculations if TVA thought it necessary to do so [Doc. 204, at 50]. Any Rule 26 violation in this case was thus harmless. The Court therefore overrules TVA's objection to Mr. Koppe's emissions calculation for the 1984-86 baseline period.

D. TVA'S Objections to the Deposition Testimony of S. David Freeman

Plaintiffs have submitted excerpts from the deposition testimony of S. David Freeman, who served for a time as Chairman of TVA's Board of Directors [Doc. 204, at 110-11]. The Court admitted those excerpts subject to TVA's objections and counter-designations filed as

Doc. 192 [Doc. 204, at 111].[5] In support of its objection, TVA contends that Mr. Freeman's testimony is irrelevant, as much of that testimony relates to another lawsuit in Alabama [Doc. 212-1, at 21]. TVA further contends that portions of Mr. Freeman's opinion testimony as to the meaning and application of the "routine maintenance, repair, and replacement" exclusion constitute improper opinion testimony [Doc. 212-1, at 21].

Since trial, the parties appear to have agreed as to an appropriate disposition with respect to Mr. Freeman's deposition testimony. *Compare* Doc. 214, at 3 (Plaintiffs' Proposed Findings of Fact and Conclusions of Law) ("[T]he Court notes that it will take into account the arguments made in TVA's objections in determining what weight is properly afforded to Mr. Freeman's testimony.") *with* Doc. 212-1, at 21 (TVA's Proposed Findings of Fact and Conclusions of Law) ("The Court will admit the deposition designations and counterdesignations for Mr. Freeman . . . and will consider that testimony to the extent the Court finds it has any probative value in this matter."). In light of this agreement, the Court overrules TVA's objection.

The Court now makes its findings of fact.

---

[5] On September 16, 2009, after the conclusion of trial, the parties submitted a joint motion to clarify the record [Doc. 218]. The parties explained in their joint motion that the Court inadvertently referred to, and admitted, Document 190 instead of Document 192 at trial on June 3, 2009 [Doc. 218]. The Court granted the joint motion on January 28, 2010, admitting Documents 190 and 192 into evidence, and instructing that TVA's deposition designations in Defendant's Exhibit 148 would be subject to plaintiffs' objections as set forth in Document 193, and plaintiffs' counter-deposition designations for Mr. Stephens, set forth in Document 190 [Doc. 221].

III. Findings of Fact

The Court makes findings of fact with respect to the parties, the operation of coal-fired power plants, the specific features of Bull Run, maintenance operations and outages, electricity supply and demand, approval and accounting procedures, the economizer replacement at Bull Run, and the superheater replacement at Bull Run. The Court does not make findings of fact or reach conclusions of law with respect to emissions because it does not reach the emissions issue in this case.

A. Parties

The NPCA is a nonprofit citizen organization dedicated to protecting the interests of its members in the U.S. National Parks System, in forests, wildlife, wilderness, recreation, open space, reduction of pollution in all forms, and other environmental matters.[6] Founded in 1919, the NPCA has approximately 6,680 members in Tennessee, and over 450,000 members nationwide. The Sierra Club is a national conservation organization that is likewise dedicated to the protection of national resources. It has approximately 4,800 members in Tennessee, and 600,00 members in total. OCE is a nonprofit public benefit organization organized under California law. Its principal place of business is California. OCE is a membership organization dedicated to protecting the public, especially children, from the

[6] Sentences in Part III for which citations are not provided are drawn from the stipulations of fact in the pretrial order [*see* Doc. 185]. All other sentences are cited as necessary. Citations to witness testimony are provided as appropriate.

health impacts of pollution and other environmental hazards, and to improving environmental quality for the public benefit.

TVA is a corporate agency and instrumentality of the United States. It was created, and exists, pursuant to the Tennessee Valley Authority Act of 1933, *as amended*, codified at 16 U.S.C. §§ 831-831ee (the "TVA Act"). TVA maintains and operates one of the nation's largest electric power systems as part of its statutory mission to develop the resources and economy of the Tennessee Valley. This integrated system of electricity-generating facilities includes eleven coal-fired electricity generating plants, and comprises fifty-nine units in Kentucky, Tennessee, and Alabama. TVA is authorized to produce, distribute, and sell electric power under the TVA Act. 16 U.S.C. § 831d(l).

B. Operation of Coal-Fired Power Plants

The Court now discusses the operation of coal-fired power plants.[7] In doing so, the Court first provides an overview, and then details the processes of coal combustion, steam production, and electricity generation.

1. Overview

A coal-fired power plant generates electricity by burning coal to create steam, and then passing that steam through a turbine. The turbine drives a generator that produces electricity. Much of this generation occurs in a large, building-like structure called a boiler. The boiler is eighteen stories tall, and contains thousands of steel tubes in which water is

[7] The operation of plants as described in this section applies to the operation of Bull Run.

heated to superheated steam. The boiler consists of collections of tube assemblies, including the economizer, where water is initially heated; the furnace waterwall tubes, where water evaporates to steam; the superheater tubes, where the temperature of the steam is raised just before the steam exits the boiler and reaches the turbine; and the reheater tubes, where steam from the turbine is reheated and returned to the turbine. The furnace waterwall tubes form the wall of the boiler, provide an envelope for coal combustion, and absorb heat.

An electric generating unit like the one just described consists of thousands of components that must work together in order for the unit to operate [Doc. 204, at 167 (Golden Testimony)].[8] These components are subject to varying stresses during normal operation; have different failure mechanisms; and have different failure rates [Doc. 204, at 167-68 (Golden Testimony)].

2. The Coal Combustion Process

One of the first steps in the electricity generation process is the delivery of coal to the furnace. Coal is delivered to the furnace as follows: Coal feeders at the outlets of the silos or bunkers receive control signals that determine the amount of coal needed by the boiler. Those feeders then deliver the required amount of coal to pulverizers. The pulverizers grind the coal to the size and consistency of talcum powder. This finely ground coal is then transmitted to coal burners. The burners mix the coal and the air, while introducing both into

[8] References to "Golden Testimony" are to the trial testimony of Jerry Golden, TVA's expert witness on routine maintenance, repair, and replacement.

the furnace. Combustion occurs in the furnace. Temperatures in the furnace may reach 2500º to 3500º Fahrenheit.

Carbon dioxide, nitrogen oxides, sulfur dioxides, and other gases, referred to collectively as "flue gases," are byproducts of the process of burning the coal in the boiler. This process is known as "coal combustion." The flue gas radiates energy to the surrounding enclosure of the furnace. This enclosure consists of tubing with high pressure water flowing inside. The water in these tubes serves two purposes: it (1) cools and protects the tubing that comprises the furnace enclosure; and it (2) receives energy necessary to convert the water to steam. The flue gas also radiates energy upwards toward the roof of the furnace, where boiler designers ordinarily install an additional heat exchange surface as a part of the superheater.

The flue gas flows, with the help of fans, from the furnace through the convection pass. The primary heat transfer mode in this section of the boiler is convective. This convection is produced by the movement of the hot gases over stationary tubing. The heat exchange surfaces normally found in the convection pass include superheaters, reheaters, and economizers.

At this point, the flue gas, now cooled to 650º to 800º Fahrenheit, flows to another heat exchange device: the air heater. In this device, ambient air is heated before going to the pulverizers or to the burners. In the process of heating the air, the flue gas cools further to about 300º to 325º Fahrenheit. After the flue gas leaves the air heater, it flows to an electrostatic precipitator that removes solid ash particles freed by the combustion of coal and entrained as the flue gas leaves the furnace. The flue gas then flows out of the stack.

3. The Steam Production Process

The steam production feature of a power plant is a closed-loop process in which steam condenses, returns to the boiler as a liquid, converts to steam, passes through the turbines, and condenses again. The steam condensed to liquid water in the condenser flows through a series of pumps that increase the liquid pressure and heat exchangers that use a part of the steam flowing through the turbine to increase the liquid temperature. The liquid water then enters the economizer, which is the first boiler section encountered by the liquid water and the last boiler section encountered by the flue gas.

Water flows directly from the economizer to headers located around the boiler. Water then flows from these headers to individual tube circuits. The water receives energy while the water is in the individual tube circuits. Water flow persists until all of the liquid water is converted to steam. The steam then collects in headers, and flows through pipes to the superheater inlet headers.

The steam inside the superheater tubes is at its highest temperature and pressure levels. At the same time, the flue gas outside the tubes is at its highest temperature. Steam flows from the superheater to and through the high pressure turbine, where it transfers a significant portion of its energy, and loses both temperature and pressure. The steam then returns to another convective section of the boiler known as the reheater. In the reheater, the lower pressure steam is heated to 1000º to 1050º Fahrenheit.

4. The Electricity Generation Process

The steam turbine includes three separate sections: high pressure, intermediate pressure, and low pressure turbines. Each of these sections contains alternating rows of blades attached to the stationary casing of the turbine and to a shaft that rotates inside the turbine. The passage of steam through these rows of blades provides the energy to turn the rotating shaft.

The generator rotor is an electromagnet that connects to, and turns with, the turbine shaft. The generator rotor turns inside a stator that contains rows of electrical conductors. As the magnetic field of the rotor passes through the conductors of the stator, the field produces electrical current in the stator. The current flows from the stator to a transformer, which increases the voltage of the current to the level needed for the current to flow through the transmission lines and carry electricity to the user.

C. Bull Run

The Court next discusses Bull Run, including plant specifics and plant performance.

1. Plant Specifics

Bull Run is a single unit, supercritical, coal-fired electricity generating plant located in Clinton, Tennessee. It began operation in 1967. It is one of the younger units in the TVA system. Bull Run has a maximum generator nameplate rating of 950 megawatts. It is a "major stationary source" or "major emitting facility" as those terms are defined in 42 U.S.C.

§ 7602(j). TVA has been, at all times relevant to this lawsuit, the "owner" and "operator" of Bull Run, as those terms are defined in TAPCR 1200-3-2-.01(hh).[9]

Bull Run's boiler contains approximately 300 miles of steel tubing. Bull Run also has twin, divided furnaces. Each furnace has a separate, but identical, convection section. Each convection section includes a vertical finishing superheater; a vertical reheater; a low-temperature vertical superheater; a horizontal superheater; a horizontal reheater; and an economizer. When it is operational, Bull Run burns more than 300 tons of coal per hour in its pressurized, tangentially fired, supercritical, combined circulation furnaces. Bull Run produces 6,400,000 pounds per hour of steam at 3650 per square inch gauge ("psig") and 1003º Fahrenheit.

2. Plant Performance

Bull Run has been one of the better performers in the TVA fossil generating system. It was a "good performing plant" in terms of heat rate and availability during the 1980s. Bull Run has been ranked by Electric Light & Power magazine as the most efficient coal-fired power plant in the nation thirteen times. It is consistently ranked among the top five plants of its kind in the country. During calendar years 1983 to 1988, Bull Run won five awards from Electric Light & Power for having the top coal-fired plant heat rate in the nation. In the 1980s, Bull Run was arguably the best-performing steam generating unit in the TVA fleet,

---

[9] References to the "TAPCR" are to the Tennessee Air Pollution Control Rules.

both in terms of cost and efficiency [Doc. 203, at 29-30 (Hekking Testimony)].[10] TVA expected that Bull Run would operate for sixty years [Doc. 201, at 94-95 (Golden Testimony); Def.'s Ex. 44, at 34].

D. Maintenance Operations and Outages

The Court now considers maintenance operations at coal-fired power plants, maintenance operations at TVA, maintenance expenditures at Bull Run, outages at coal-fired power plants, and outages at Bull Run.

1. Maintenance Operations at Coal-Fired Power Plants

Successful operation of a power plant requires an active maintenance program [Doc. 202, at 124 (Hekking Testimony)]. There are several categories of maintenance. These include running maintenance, preventive maintenance, predictive maintenance, and reactive or "forced outage" maintenance.

Running maintenance involves relatively minor maintenance tasks that are performed on a regular, repetitive basis while a unit is in operation, like the calibration of instruments [Doc. 202, at 90-91 (Hekking Testimony)]. In-house plant staff typically have the necessary skills, parts, and labor to perform running maintenance [Doc. 203, at 111 (Hekking Testimony)]. Running maintenance is normally approved at the foreman or supervisor level [Doc. 203, at 111 (Hekking Testimony)]. It is accomplished over a period of hours, days, or

[10] References to "Hekking Testimony" are to the trial testimony of Alan Hekking, plaintiffs' expert witness on routine maintenance, repair, and replacement.

weeks [Doc. 203, at 111 (Hekking Testimony)]. And it is paid for out of a plant's operating and maintenance budget [Doc. 203, at 128-29 (Hekking Testimony)].

Preventive maintenance involves regularly scheduled maintenance tasks performed during planned outages,[11] like opening, inspecting, and repairing ducts, fans heaters, heat exchangers, and tanks [Doc. 202, at 105 (Hekking Testimony)]. This type of maintenance is performed in order to prevent a component from breaking [Doc. 202, at 89 (Hekking Testimony)]. A related category of maintenance is predictive maintenance. Predictive maintenance involves the continuous monitoring of a piece of equipment in order to predict whether it will fail [Doc. 202, at 89-90 (Hekking Testimony)]. Finally, reactive, or forced outage, maintenance involves maintenance work performed to repair a piece of equipment after it breaks [Doc. 202, at 90 (Hekking Testimony)].

The funds for capital improvement projects, in contrast to maintenance projects, do not come out of plant-specific annual maintenance budgets [Doc. 202, at 112 (Hekking Testimony)]. The industry distinguishes between routine maintenance operations and capital improvement projects [Doc. 202, at 114, 140-41 (Hekking Testimony); Def.'s Ex. 159a, at 2-1, 10-3, 10-4, 10-11, 27-1-4 (internal pagination); Def.'s Ex. 41, at 5].

2. Maintenance Operations at TVA

TVA has been operating and maintaining coal-fired electric generating units since 1933 [Doc. 204, at 186 (Golden Testimony)]. Its mission since at least 1972 has been to

[11] Planned outages are discussed *infra* Part III.D.4.

maintain the highest practical level of availability and reliability at its plants, while preserving its assets, providing energy at the lowest cost to the ratepayers, and maintaining safe and environmentally sound operations [Doc. 204, at 188-89 (Golden Testimony); Def.'s Ex. 41, at 25]. TVA's maintenance operations are representative of the industry [Doc. 204, at 188 (Golden Testimony); Doc. 202, at 69 (Hekking Testimony)].

From 1972 to the present, TVA has performed capital projects on its coal-fired units in order to improve the availability and/or reliability of those units [Doc. 201, at 41 (Golden Testimony); Def.'s Ex. 43, at 5-6]. In 1978, TVA formally established an availability improvement program [Def.'s Ex. 158]. This included the formation of an availability and reliability improvement task force (the "task force") [Def.'s Ex. 158, at 30-31]. The objectives of the task force included improving the reliability and availability of TVA's thermal power plants; identifying specific plant features and equipment which had caused significant outages or which had the potential for reducing plant availability and reliability; and identifying design and operational changes in existing and future plants which would improve the availability of plants and reduce forced outages [Def.'s Ex. 158, at 31]. The availability and reliability improvement projects identified by the task force included a number of boiler tube component replacements, a subgroup of which included the replacement of superheaters and economizers [Def.'s Ex. 158, at 40].

TVA's availability improvement program was designed in part to help TVA provide a coordinated response to industry requests for advice on efforts to improve the availability and reliability of coal-fired units [Def.'s Ex. 158, at 31]. Efforts like these were common in the industry from the late 1970s and into the 1980s [Doc. 204, at 106 (Koppe Testimony)].[12] TVA had a strong interest in 1978 in improving the reliability of existing coal-fired power plants; this interest included stepping up efforts to reduce outages at existing plants [Doc. 192-2, at 18-19].

In the mid-1980s, actors in the utility industry began discussing the benefits of bundling individual availability or reliability improvement projects together under the term "life extension" [Def.'s Ex. 162, at 8]. Extending the life of aging fossil plants was seen as a viable alternative to financing and obtaining the regulatory permits necessary to build new plants [Def.'s Ex. 163, at 7]. The EPA was aware of availability and reliability improvement programs, and life extension programs, in place at utilities during this period [Doc. 204, at 207-09 (Golden Testimony); Def.'s Ex. 160, at 6].

TVA investigated the possibility of performing life extension projects on its fossil units under the aegis of the Fossil and Hydro Unit Evaluation and Modernization Program (the "FHUEM") [Doc. 203, at 10-14 (Hekking Testimony); Doc. 204, 123-25 (Golden Testimony)]. TVA never fully implemented that program [Doc. 203, at 10-14 (Hekking Testimony); Doc. 204, 124-25 (Golden Testimony)]. Instead, TVA reverted to a "business-as-usual" assessment of projects on a project-by-project basis, rather than on a unit-by-unit basis [Doc. 204, at 124-25 (Hekking Testimony)]. The 1988 Bull Run economizer and

[12] References to "Koppe Testimony" are to the trial testimony of Robert Koppe, plaintiffs' expert witness on the emissions issue.

superheater replacement projects were not part of the FHUEM [Doc. 203, at 164 (Hekking Testimony)].

3. Maintenance Expenditures at Bull Run

Total plant-wide annual maintenance expenditures for Bull Run in the years leading up to the projects at issue in this case are summarized as follows:

Year	**Expenditures (in millions of dollars)**
1980	3.662
1981	6.095
1982	7.853
1983	6.559
1984	9.593
1985	10.206450
1986	7.117541
1987	11.606013

4. Outages at Coal-Fired Power Plants

Improving, or lowering, the heat rate of an operating unit means that the unit needs to burn less coal to generate the same amount of electricity. This lowering reduces the costs and emissions associated with generating each kilowatt-hour of electricity. It can be achieved through the use of outages.

"Outages" occur when a generating unit is shut down. "Planned outages" occur periodically, and involve advance planning and scheduling for work to be done during the planned outage. Planned outages at plants the size of Bull Run typically range from four to sixteen weeks [Doc. 204, at 179-80 (Golden Testimony)]. A "forced outage," by contrast, is unplanned. It results from the failure of individual components. During a forced outage, repair efforts are often focused on the problem causing the outage. An outage to repair a boiler tube leak is an example of a forced outage.

Forced outages tend to stress units, through the repetition of shut-down and start-up cycles [Doc. 204, at 176-77 (Golden Testimony)]. Forced outages impose costs on the utility, the ratepayers, and the environment [Doc. 204, at 176-77 (Golden Testimony)]. For these reasons, utilities prefer to work on items like leaky boiler tubes when a unit is already scheduled to be in a planned outage for other work [Doc. 204, at 178 (Golden Testimony)]. Utilities perform maintenance in part in order to reduce the number and length of forced outages [Doc. 204, at 16 (Koppe Testimony)].

Boiler tube leaks were, and remain, the predominant cause of forced outages at TVA plants and in the industry in general, because these leaks require immediate repair [Doc. 202, at 91 (Hekking Testimony)]. No maintenance, repair, or replacement related to boiler tubes can take place while the unit is operating, given the temperature, pressure, and condition of the boiler during that time [Doc. 204, at 177-78 (Golden Testimony)]. Depending upon the location and size of such a leak, the leak can pose a threat to the safety of plant employees [Doc. 204, at 176 (Golden Testimony)]. Forced outages related to boiler tube leaks typically last for two or three days [Doc. 204, at 179 (Golden Testimony)].

During the time period relevant to the projects at issue in this case, the approval of TVA's upper management was not required for the initiation of tube leak repair, unless the work was outsourced. At times only the plant manager's approval was required to hire a contractor, who would supervise such outsourcing and perform this maintenance. Like most other utilities, TVA maintains replacement tubing and selected fittings (*e.g.*, elbows) in inventory so that minor replacement and repair work can be handled at the plant quickly, efficiently, and cost-effectively.

It was common practice in the 1970s and 1980s to shut down generating units once every year or two as part of a planned outage in order to maintain coal-fired electric power plants. Such outages typically involved detailed planning and scheduling for work that was conducted during such outages. This planning and scheduling occurred months or years in advance. During the time period relevant to the projects at issue in this case, TVA maintenance staff at a given plant would maintain a list of activities to be performed during each planned outage.

Also during this time period, TVA used contractors and temporary craftsmen from union halls for the performance of some forced outage work when extra resources were needed, or when existing maintenance staff lacked the experience or certification necessary to make repairs to pressure parts. TVA sometimes used outside contractors for smaller jobs, like the installation of shielding on economizers to combat fly ash erosion [Doc. 204, at 213-14 (Golden Testimony)]. In addition, the labor and services of a plant's original equipment manufacturers were sometimes assigned as "partners" of that plant; these partners maintained offices in the plant [Doc. 201, at 43-44 (Golden Testimony)]. It was not uncommon in the industry, or within TVA, for a plant to hire labor from outside the plant to perform or assist with some plaint maintenance projects [Doc. 201, at 43-44 (Golden Testimony)].

It is not uncommon in the utility industry for unrelated projects to take place during the same outage [Doc. 204, at 180-81 (Golden Testimony)]. The scope of work to be completed during an outage also may change over time [Doc. 204, at 180-81 (Golden Testimony)]. Projects scheduled to be completed during one outage may be rescheduled for another outage, for a variety of reasons [Doc. 204, at 182 (Golden Testimony)].

5. Outages at Bull Run

The planned outage history for Bull Run before 1988 is summarized as follows:

Start Date	End Date	Outage Hours	Outage Days	Outage Weeks
03/31/1969	06/18/1969	1879	78.3	11.2
03/10/1970	05/06/1970	1363	56.8	8.1
03/27/1971	04/27/1971	748	31.2	4.5
03/15/1972	05/24/1972	1688	70.3	10
09/27/1975	12/07/1975	1726	71.9	10.3
09/30/1977	12/17/1977	1872	78	11.1
02/21/1979	05/16/1979	2007	83.6	11.9
03/22/1980	04/04/1980	305	12.7	1.8
10/03/1980	11/24/1980	1253	52.2	7.5
03/10/1982	05/17/1982	1625.95	67.7	9.7
09/23/1983	12/08/1983	1814.57	75.6	10.8
03/22/1985	06/13/1985	1991.58	83	11.9
09/19/1986	12/01/1986	1734.1	72.3	10.3

Using 15.3 weeks as the outage time for the 1988 outage at Bull Run, the average planned outage duration for Bull Run between 1969 and 2007 was 8.2 weeks [Def.'s Ex. 6].[13] Bull Run was unavailable over 20% of the time in 1987 because of forced outages [P.'s Ex. 229, at 11].

Prior to the 1988 outage, TVA had conducted several furnace rehabilitation projects at Bull Run, including the replacement of substantial numbers of tubes in the reheater, waterwall, and superheater sections of the boiler. Such projects included, among others, the installation of thirty-two additional inlet headers and sixteen outlet headers in the superheater; replacement of all 146 horizontal reheat elements in both furnaces; replacement of all rear hopper slope tubes and 160 front hopper slope tubes in both furnaces; and replacement of a number of waterwall and superheater outlet pendant tubes [Def.'s Ex. 166]. Some of these projects would have involved rigging and material handling [Doc. 203, at 153 (Hekking Testimony)]. Some would have required cutting into the furnace to gain access; the use of cranes and outside resources; more than a year of project planning; and authorization beyond plant management [Doc. 203, at 153-54 (Hekking Testimony)]. Many of these projects were capitalized [Def.'s Exs. 60, 61].

The economizer and superheater replacements were not the only projects conducted during the 1988 planned outage at Bull Run. During this outage, TVA also replaced some

[13] TVA contends that the total duration of the 1988 outage was 15.3 weeks [Def.'s Ex. 6]. Plaintiffs contend that the total duration of the 1988 outage was 15.4 weeks, despite referencing Defendant's Exhibit 6 for this figure [Doc. 214, at ¶ 44]. The Court uses 15.3 weeks as the appropriate figure.

of the waterwall tubing; applied a metal coating to some of the waterwall tubing; replaced portions of the blades in the high-pressure and low-pressure turbines; and chemically washed the copper deposits that had accumulated on the turbine [Doc. 204, at 70-71 (Koppe Testimony)]. The turbine work was expected to reduce the turbine-related forced outage rate at Bull Run from 15.2% to 0% [Doc. 204, at 75 (Koppe Testimony)]. The bulk of the availability or reliability improvement expected after the spring 1988 outage was associated with the turbine work [Doc. 204, at 75 (Koppe Testimony)].

E. Electricity Supply and Demand

The Court next discusses electricity supply and demand in general and at TVA.

1. Generally

Even when a unit is available to generate power, a utility may choose not to run the unit, or to run the unit to generate less output than it is capable of at the moment. Using (or not using) a unit in this way typically occurs when the use of electricity by consumers is reduced, and/or when other units are available to generate electricity at a lower cost. Units are also operated from time to time at outputs below capability, because there is not a need for all of the power that a unit can produce. This situation is called a "turndown."

Every generating unit shuts down periodically for equipment overhauls and modifications, and because of equipment failures [Doc. 203, at 190-91 (Koppe Testimony)]. When a unit is shut down in this way, it is not able to operate, and is said to be "unavailable" [Doc. 203, at 191 (Koppe Testimony)]. When the unit is not shut down, and is able to generate electricity, it is said to be "available" [Doc. 203, at 191 (Koppe Testimony)].

"Utilization factor" is the measure of how much a utility uses a unit; in other words, how much electricity a unit generates when it is available [Doc. 203, at 213 (Koppe Testimony)]. If a utility always operates a unit at full power whenever it is available, that unit's utilization factor would be 100%, or "1" [Doc. 203, at 213-14 (Koppe Testimony)]. On the other hand, if a utility never uses a unit when the unit is available, that unit's utilization factor would be 0%, or zero [Doc. 203, at 214 (Koppe Testimony)].

Electrical power cannot practically be stored in significant quantities on a utility scale. Electricity generation must therefore be adjusted continuously to match ever-changing power demands. The operating level of a particular unit, from out-of-service status to 100 percent output, is determined by system requirements, including the demand for electricity and the need to adjust the output of particular plants to maintain system voltage across the entire electric grid. For a particular unit to operate, and thus to emit, it must be true both that the unit is available, meaning that every critical component must be working and that there is demand to run the unit.

2. TVA

TVA's fiscal year runs from October 1 through September 30. The planned outage during which the 1988 projects took place occurred during fiscal year 1988. The demand for power from customers was expected to increase after 1988. Demand on TVA's system did increase after the 1988 projects. TVA's total system-wide sales of electricity during the three years before, and during the three years after, the projects were as follows:

Pre-1988		Post-1988	
Fiscal Year	Sales (in thousands of kilowatt hours)	Fiscal Year	Sales (in thousands of kilowatt hours)
1985	103,543,895	1989	111,592,013
1986	102,593,504	1990	116,483,057
1987	106,097,229	1991	116,930,773

The TVA Act mandates that TVA sell power at rates that are as low as feasible. 16 U.S.C. § 831n-4(f). To sell power at the lowest feasible rates, TVA takes steps to ensure that it organizes and operates its generating units in an economic fashion. The units with the lowest production costs are operated most frequently. Conversely, the units with the highest production costs are operated least frequently. TVA maintains a list of the dispatch order for its generating units, which sorts these units by production costs. Units with the lowest production costs, *i.e.*, those that are called upon to produce electricity most frequently, are at the bottom of the list.

After the 1988 projects, Bull Run was in either the same place, or in a higher place (meaning that it would be less likely to be called upon to operate), on the dispatch list. In other words, TVA did not change the dispatch order of Bull Run after the 1988 projects in a way that would have made the unit likely to operate more frequently.

F. Approval and Accounting Procedures

The Court provides an overview of approval and accounting procedures at utilities in general. It then discusses approval and accounting procedures at TVA.

1. Overview

When replacement of a component at a plant becomes necessary, utilities follow standard procedures. These procedures begin with the identification of a problem through data-gathering activities, or through the failure of a component [Doc. 201, at 37 (Golden Testimony)]. The utility then engages in a series of discussions to identify potential solutions to the problem [Doc. 201, at 37 (Golden Testimony)]. Each solution is typically evaluated, subjected to a cost-benefit analysis, and considered alongside different alternatives [Doc. 201, at 38 (Golden Testimony)]. The preferred solution is then usually selected at the staff level, and submitted to management for approval [Doc. 201, at 38 (Golden Testimony)].

In a typical component replacement project, the utility will evaluate whether it makes sense to upgrade the component in terms of materials or design [Doc. 201, at 44 (Golden Testimony)]. If a component is available in a material or design that will perform the same function better, but for an equivalent cost, a utility may decide to upgrade to that improved component [Doc. 204, at 185 (Golden Testimony)].

The time from project identification to project implementation varies [Doc. 204, at 182-83 (Golden Testimony)]. Several variables may affect the length of time that passes from project identification to implementation, including the inability of the supplier to provide needed equipment on time, the unavailability of a utility's resources, changing electric grid conditions, or the need to gather additional data [Doc. 204, at 181-82 (Golden Testimony)].

2. Approval and Accounting at TVA

The economizer replacement project, and the partial superheater replacement project, were two projects. Neither project was technically or economically dependent on the other. Each project was identified separately, evaluated separately, and approved separately. Had TVA undertaken only piecemeal replacement of tubes in the economizer and the superheater as tubes failed, the probable consequence would have been reductions in availability until all tubes had been repaired or replaced.

The manner in which a utility treats a project for accounting purposes is governed by a set of accounting rules and guidelines which are designed to ensure consistent accounting treatment throughout the industry [Doc. 201, at 38-39 (Golden Testimony)]. These accounting principles, as well as TVA's capitalization policy, draw a distinction between capital expenditures and maintenance expenditures [Doc. 202, at 107-08; 115-17; 119-20 (Hekking Testimony); P.'s Ex. 50, at 1-2]. It would have been inconsistent with the accounting rules followed by TVA to treat the costs for the 1988 economizer and superheater projects as maintenance expenses chargeable to TVA's operating budget. It would also have been inconsistent with the Uniform System of Accounts established by the Federal Energy Regulatory Commission ("FERC") to treat the costs for these projects as operating and maintenance expenses.

The costs charged to these projects were classified as capital improvement by TVA. Capital improvement projects generally result in the improvement of the value of an asset, or represent the addition of a new asset [Doc. 202, at 107 (Hekking Testimony)]. Capitalized maintenance is an ongoing activity [Doc. 201, at 41 (Golden Testimony); Def.'s Exs. 60, 61]. When major portions of a plant, or significant items of equipment, are replaced, the costs of that replacement are significantly higher than normal operations and maintenance costs, and are capitalized separately under the heading "replacements" [Def.'s Ex. 43, at 6]. TVA performed more than 2,000 capital projects at its coal-fired power plants between 1969 and 1988 that each exceeded $100,000 in cost [Doc. 201, at 41-42 (Golden Testimony)].

Proceeding with capital improvement projects like the Bull Run projects would require high-level approval from TVA management [Doc. 202, at 120, 140-41 (Hekking Testimony)]. Submitting projects like these for approval would also typically require the contemporaneous submission of a benefit-cost analysis [Doc. 202, 109-11 (Hekking Testimony)]. Generally speaking, projects with higher benefit-cost ratios are more likely to be approved by management than projects with lower benefit-cost ratios [Doc. 202, at 114 (Hekking Testimony)].

Performing the tasks necessary to complete the economizer and superheater projects was beyond the capabilities of the maintenance staff at Bull Run [Doc. 203, at 98 (Hekking Testimony)]. Additionally, the planning for these projects took a number of years to complete [Doc. 203, at 66 (Hekking Testimony)]. Thus, TVA's central offices, rather than the Bull Run maintenance staff, handled management and oversight of the projects [Doc. 203, at 66 (Hekking Testimony)]. The TVA Board of Directors approved the economizer project [Doc. 203, at 106-08 (Hekking Testimony)]. There is no direct evidence that the TVA Board approved the superheater project. But a project on the scale of the superheater project could not have been approved at the plant maintenance level [Doc. 203, at 108 (Hekking Testimony)].

G. Economizer Replacement

The Court now turns to the particulars of the economizer replacement at issue in this case.

1. Economizer Parts and Function

The major components of the economizer are the inlet header, the heat exchange tubes or elements, and the outlet header. Economizer tubes are exposed to the highest internal water pressure of any boiler component. Because Bull Run is a twin furnace plant, it has two completely separate, but identical, economizers, one in the "A" furnace and one in the "B" furnace. There is no physical constraint on replacing all of the economizer elements in the B furnace without replacing any of the economizer elements in the A furnace.

The economizer is usually the last heating surface in the flue gas stream before the gas stream exits the steam generator and passes through the combustion air preheater. Feedwater first passes through the economizer. Combustion gases that have already passed through much of the boiler, and which are relatively cool, pass over the outside of the economizer tubes. Water in the tubes is heated further, but in most cases, the water is still not hot enough to boil.

Because the economizer's function is to squeeze more heat out of the last of the hot air as it exits the boiler, the economizer requires a great deal of surface area relative to other tubes in the boiler. The economizer tubes snake back and forth in order to provide the large amount of surface area required. As a result, the economizer tends to have more tubing than other sections of the boiler. This tubing in some cases can be 100,000 feet long. Replacing the economizer thus means replacing a large amount of tubing relative to that of other components. The Bull Run economizer is roughly sixty-one feet wide in each furnace, for a total of 122 feet, twenty feet tall, and thirty feet deep [Doc. 203, at 20 (Hekking Testimony)].

Economizers are located in the coolest area of the boiler [Doc. 203, at 116 (Hekking Testimony)]. For that reason, economizer tube sections can be expected to have the longest life of any tube section in a boiler [Doc. 203, at 116-18 (Hekking Testimony)]. Economizers typically last forty years or more [Doc. 203, at 118 (Hekking Testimony)]. A design flaw in Bull Run's original economizer effectively cut the useful life of the economizer in half [Doc. 203, at 32-36, 117-18 (Hekking Testimony)].

2. Project Background

The combustion gases that flow through the tubes of the economizer carry considerable amounts of ash from the coal burned in the furnace. This ash can erode the outside surface of the tubes, in a process analogous to sandblasting. Eventually, the walls of the tubes wear down such that they can no longer withstand the pressure of the water inside. At this point, a tube will burst, and the unit must be shut down to replace the failed section of tubing.

Quite a few of the large, coal-fired plants built in the 1960s and 1970s had replaced their economizers prematurely by the 1980s [Doc. 204, at 103-05 (Koppe Testimony)]. Prior to the 1988 outage, TVA had performed three partial economizer replacements at its Widows Creek Plant, all in 1979 [Doc. 208, at 52-62 (Golden Testimony); Def.'s Ex. 44, at 77-78]. TVA had never performed a complete economizer replacement at any plant in its system prior to the 1988 replacement at Bull Run [Doc. 208, at 52-62 (Golden Testimony)].

TVA began to plan for the full-scale replacement of the economizer at Bull Run in December 1984. TVA obtained a preliminary price estimate, and set an installation date of 1986. Subsequent inspections in 1985, however, indicated that the erosion rate in the economizer was not as severe as previously thought. The project was delayed, and was not actually performed until the planned outage in the spring of 1988.

3. Project Specifics

Although Bull Run has thousands of components, the 1988 projects addressed problems with only a few of those components [Doc. 204, at 67-68 (Koppe Testimony)]. On March 11, 1988, a planned outage began at Bull Run [Doc. 203, at 85 (Hekking Testimony)]. This planned outage lasted until June 26, 1988 [Doc. 204, at 72 (Koppe Testimony)]. During the 1988 outage, work was performed on certain boiler components at Bull Run, including the waterwall tubing, turbine blades, the economizer, and the finishing superheater. All of the economizer elements in both furnaces at Bull Run were replaced.

The work on the economizer and superheater was completed by June 1, 1988 [Doc. 204, at 72 (Koppe Testimony)]. In other words, it took no more than 11.6 weeks to complete the economizer and superheater replacement work in 1988 [Doc. 201, at 55 (Golden Testimony). The outage time between June 1, 1988 and June 26, 1988 was the result of work on a turbine that failed unexpectedly [Doc. 201, at 55 (Golden Testimony); Doc. 204, at 72-73 (Koppe Testimony)].

Prior to being replaced, the economizer at Bull Run experienced failures due to design deficiencies and/or wear out [Doc. 203, at 34-36, 162 (Hekking Testimony). Inspection of the economizer elements as early as 1975 revealed severe tube damage as a result of exposure to fly ash. Fly ash erosion of economizer elements was one of the most common causes of economizer failures in the industry [Doc. 204, at 212-13 (Golden Testimony)]. Mitigation measures were taken at Bull Run to slow the rate of erosion. These measures met with some success. As early as 1982, however, TVA was considering the total replacement of the economizer at Bull Run, when the unit was only fifteen years old.

4. Routine Maintenance, Repair, and Replacement

The Court now makes findings of fact with respect to the factors for determining whether the economizer project constitutes routine maintenance, repair, or replacement, as those terms are discussed *infra* Part IV.B. These factors include the nature and extent of the project; the purpose of the project; the frequency with which a project of this sort is conducted, both at the unit and in the industry as a whole; and the cost of the project.

a. Nature and Extent

The economizer project required the removal and replacement of all of the economizer tube elements in both furnaces at Bull Run. This project work amounted to the replacement of over sixty-seven miles of two-inch diameter tubing, weighing approximately 887 tons [Doc. 203, at 22 (Hekking Testimony)]. This material was ordered from an outside contractor [Doc. 203, at 66-67 (Hekking Testimony); P.'s Ex. 36]. The outside contractor designed and procured this material over a period of months, and delivered it to Bull Run for installation [Doc. 203, at 67-69 (Hekking Testimony)]. The tubing material for this job would have filled twenty to thirty 18-wheel flatbed trucks [Doc. 203, at 73 (Hekking Testimony)].

Removing the old economizer and superheater material from Bull Run's boiler, and installing the new material in its place, required cutting a number of holes in the walls of the plant's furnaces [Doc. 203, at 69-79 (Hekking Testimony)].[14] Removal and installation also necessitated the use of cranes, monorails, and an extensive rigging system designed to assist in moving large and heavy material in and out of the boiler [Doc. 203, at 73-75 (Hekking Testimony)]. TVA would have had to hire a large number of outside craftsmen and laborers to complete the economizer and superheater projects, including sixty to one hundred boilermakers working rotating shifts [Doc. 203, at 81-82 (Hekking Testimony)].

The TVA Board of Directors approved the 1988 Bull Run economizer replacement project at a public meeting held on June 10, 1987. The meeting was preceded by a notice in the Federal Register that the Board would take up a purchase award for the "Economizer Elements for Bull Run Fossil Plant." At this meeting, the Board was informed that for this "particular vintage of plants, on most of the plants around the nation, [the economizers] have already been replaced, so we're a little late maybe on ours." The Board was further informed

---

[14] The information in this paragraph applies to both the economizer and the superheater projects.

that the project was necessary to ensure that "Bull Run Fossil Plant maintains its highly rated reliability and efficiency status." Finally, the Board was informed that the economizer replacement would "stay with the original design [of the unit] which has worked to serve Bull Run well and made it the number one plant in the United States," and which had "contributed to Bull Run['s] maintaining its status of the most efficient and reliable plant in the United States."

b. Purpose

The economizer replacement project was predictive in nature [Doc. 204, at 248 (Golden Testimony)]. It was undertaken to avoid the failure of the economizer after TVA discovered conditions that TVA believed would threaten the continued operation of Bull Run [Doc. 204, at 248 (Golden Testimony)]. TVA justified this project in the belief that it would avoid future outages caused by failure of this component, as well as related replacement power costs [Doc. 204, at 248-49 (Golden Testimony)]. Justifying the project involved comparing outages expected to be caused by failures of the economizer with the cost of replacing the economizer [Doc. 204, at 225-26 (Golden Testimony)].

In the five years preceding the 1988 Bull Run projects, there were no outages lasting longer than a few days that were attributable to leaks or other failures of the economizer [Doc. 204, at 8 (Koppe Testimony)]. There were no outages in 1987 that were the result of economizer leaks [Doc. 204, at 62-63 (Koppe Testimony)]. In the fifteen months that preceded the 1988 outage, Bull Run had suffered no downtime as a result of economizer tube leaks [Doc. 204, at 86 (Koppe Testimony)].

The economizer project was undertaken to improve the reliability of Bull Run. The work order for the 1988 economizer replacement stated, in part, that:

> Recent inspections have revealed that tubes in all areas of the economizer section are heavily damaged by external erosion caused by fly ash, thus reducing the tube wall thickness. It can be predicted that this condition will worsen and the rate of tube failures will rapidly increase until all elements in the economizer can be replaced. This work will increase the reliability of the unit and decrease the maintenance cost in this section of the boiler.

[Def.'s Ex. 18, at 1]. The economizer replacement did not increase the maximum hourly emissions capability of the unit for either sulfur dioxide or nitrogen oxides. But replacement of these elements did extend the life of this section of the boiler by approximately twenty years [Doc. 203, at 106 (Hekking Testimony)].

c. Frequency

The 1988 economizer replacement project was the first complete economizer replacement performed at Bull Run [Doc. 203, at 105, 113 (Hekking Testimony)]. The economizer at Bull Run was again replaced in April 2006. A survey of 202 plants in the industry that had economizers indicated that of those plants, 98 had undergone some economizer replacement activities as of the year 2000 [Doc. 201, at 69 (Golden Testimony); Def.'s Ex. 37, at 4, 38-39]. The average life of the economizers replaced in this survey was 23 years [Doc. 201, at 69-70 (Golden Testimony); Def.'s Ex. 37, at 38].

d. Cost

The cost of the 1988 economizer project as approved in 1985 was $8,791,000.00 [Doc. 203, at 44 (Hekking Testimony); Def.'s Ex. 18, at 1]. The actual cost of the 1988 economizer replacement was $6,456,599.14 in 1988 dollars. The cost per kilowatt for the Bull Run economizer project was approximately $9.50 in 2000 dollars [Doc. 204, at 233-34 (Golden Testimony)]. Between 1969 and 1998, TVA performed 120 capital projects at its coal-fired plants that were more expensive than the Bull Run economizer project [Doc. 204, at 232-33 (Golden Testimony)].

H. Superheater Replacement

The Court now turns to the particulars of the superheater replacement at issue in this case.

1. Superheater Parts and Function

The function of the superheater is to super heat the steam. The temperature of the water and steam steadily increases as they pass through the economizer and waterwall sections of the boiler. The water and steam pass first to the primary superheater, and then to the secondary superheater. The secondary superheater heats the steam to more than 1000º Fahrenheit. The superheater is the last section of tubes through which the steam passes before leaving the boiler and entering the main turbine. As a result, the superheater carries very high pressure steam. This is the hottest steam in the entire boiler.

The Bull Run superheater consists of a horizontal convective type primary section; division panels spaced approximately fourteen feet apart in the top front of each furnace; a platen section located between the division panels and the furnace arch nose; a finishing pendant section located above the furnace arch; and interconnecting tubing and headers. The portion of the superheater at issue in this case is known as the "secondary," "pendant," or “finishing” superheater. The Bull Run superheater is 122 feet wide, and the superheater tubes hang down thirty-seven feet from the inlet and outlet headers [Doc. 203, at 28 (Hekking Testimony)].

2. Project Background

Initially, the elements of the pendant section of the superheater in this case were made of two dissimilar metals welded together: a lower grade T-22 metal at the steam inlet of the pendant element, and a TP-347H metal at the outlet end of the pendant element. The T-22 metal was exposed to temperatures exceeding its design limit for extended periods. Exposure of this sort is one of the most common causes of superheater failure in the industry [Doc. 204, at 237-38 (Golden Testimony)]. The superheater tubes swelled as a result of this exposure. This swelling was detected in September 1981. Sections of the superheater tubing that were made of the T-22 metal were replaced with TP-347H metal [Def.’s Ex. 31, at 1].

In the five years leading up to the 1988 Bull Run projects, there were eleven outages at the unit due to superheater tube failures [P.’s Ex. 147, at 1]. Some of those outages resulted from failures of tubes that were replaced in 1986 [Doc. 203, at 228-29 (Koppe Testimony)]. Those outages were unrelated to the superheater project at issue in this case [Doc. 203, at 228-29 (Koppe Testimony)].

3. Project Specifics

Before the 1988 project, the finishing superheater pendant had 207 elements: 1.75” OD x 0.375” MWT SA 213 T11, 1.75” OD x .360” MWT SA 213 T22, 1.75” OD x .375” MWT SA 213 T22, 1.75” OD x .400” MWT SA 213 T22, 1.75” OD x .260” MWT SA 213

TP347H. After the 1988 project, the finishing superheater also had 207 elements: 1.75" OD x .260" MWT SA 213 TP347H.

4. Routine Maintenance, Repair, and Replacement

The Court now makes findings of fact with respect to the factors for determining whether the superheater project constitutes routine maintenance, repair, or replacement, as those terms are discussed *infra* Part IV.B.

a. Nature and Extent

During the planned outage in 1988, TVA replaced approximately three-quarters of the tubing in the finishing superheater at Bull Run [Doc. 204, at 69 (Koppe Testimony)]. In the course of replacing secondary superheater outlet pendant elements in 1988, TVA replaced more than 58,000 feet of tubing in the boiler. The project involved replacing the tube material with a different type of tube material [Doc. 203, at 57 (Hekking Testimony); P.'s Ex. 129, at 1]. When combined with the 1988 economizer project, this work represented the removal and replacement of more than a quarter of all of the tubing in the boiler at Bull Run [P.'s Ex. 4, at ¶ 38]. The partial superheater replacement was approved in the summer of 1987.

b. Purpose

The 1988 partial replacement of the Bull Run secondary superheater was intended to "reduce the number of forced outages, [and] increase the availability and reliability of the unit" [Doc. 203, at 57 (Hekking Testimony); P.'s Ex. 129, at 1]. It would also "extend the life of this section of the boiler by approximately 20 years" [Doc. 203, at 57 (Hekking

Testimony)]. The replacement did not increase the generating capacity of the Bull Run plant on either a continuous basis or a peaking basis. Nor did the replacement make the unit physically bigger. Nor, finally, did it increase the maximum hourly emissions capability of the unit for either sulfur dioxide or nitrogen oxides.

c. Frequency

Over the past thirty or forty years, a "fairly substantial fraction" of the coal-fired units in the industry have replaced at least some portion of their superheater [Doc. 204, at 105 (Koppe Testimony)]. A survey of 219 units in the industry found that there had been 293 full or partial replacements of superheaters that were capitalized and cost more than $100,000 [Doc. 201, at 77 (Golden Testimony)]. TVA records demonstrate that TVA had performed 123 partial or complete superheater replacement projects throughout its 59-unit system as of the year 2000 [Doc. 201, at 77-78 (Golden Testimony)]. It is not clear how many of these projects were performed prior to 1988, or how many were performed after 1988 [Doc. 208, at 78 (Golden Testimony)]. Nor is it clear how many of these projects were partial replacements, and how many were complete replacements [Doc. 208, at 78-79 (Golden Testimony)].

TVA's 1983 Retirement Plan Report does indicate, however, that eighteen superheater replacement projects had been performed within the TVA system as of 1979 [Def.'s Ex. 44, at 77]. It is not clear from that report which of those projects is comparable to the superheater replacement in this case. The 1988 secondary superheater replacement project represented the first time that the secondary superheater outlet pendants had been replaced at Bull Run [Doc. 203, at 113, 186 (Hekking Testimony)]. The outlet pendant tubes were again replaced in 2008 [Doc. 204, at 247 (Golden Testimony)].

d. Cost

The cost of the partial superheater replacement project was estimated in 1987 at $3,177,000.00 [Doc. 203, at 61 (Hekking Testimony); P.'s Ex. 129, at 1]. The actual cost of the partial superheater replacement project was $1,846,680.59 in 1988 dollars. The cost per kilowatt for the Bull Run superheater project was approximately $2.70 in 2000 dollars [Doc. 204, at 246 (Golden Testimony)].

Having made its findings of fact, the Court now makes its conclusions of law.

IV. Conclusions of Law

The Court begins with an explanation of the statutory and regulatory background applicable to this case. It then applies the routine maintenance, repair, and replacement framework to the facts to reach its conclusions of law.

A. Statutory and Regulatory Background

Congress passed the CAA in 1955 to minimize air pollution. 42 U.S.C. §§ 7401(b), (c). The 1970 amendments to the CAA directed the EPA to devise National Ambient Air Quality Standards ("NAAQS") limiting various pollutants. 42 U.S.C. § 7409. The States were directed to develop implementation plans, or "SIPs," to implement and enforce the NAAQS. *Id.* § 7410. The CAA as amended thus establishes a joint state and federal program to manage the country's air pollution. *County of Del. v. Dep't of Transp.*, 554 F.3d 143, 145 (D.C. Cir. 2009).

The 1970 amendments also required that major new sources of pollution conform to technology-based performance standards, and that the EPA establish New Source Performance Standards ("NSPS") for new and modified stationary sources of air pollution. 42 U.S.C. § 7411; *Duke Energy Corp.*, 549 U.S. at 566; *Chevron U.S.A. Inc. v. NRDC, Inc.*, 467 U.S. 837, 846 (1984). EPA regulations implementing the NSPS provide that:

> [A]ny physical or operational change to an existing facility which results in an increase in the emission rate to the atmosphere of any pollutant to which a standard applies shall be considered a modification within the meaning of section 111 of the [CAA]. Upon modification, an existing facility shall become an affected facility for each pollutant to which a standard applies and for which there is an increase in the emission rate to the atmosphere.

40 C.F.R. § 60.14(a).

"After several years under this regulatory regime, Congress recognized that merely setting ceilings on emissions did not discourage existing polluters from increasing their pollution levels up to these limits, or encourage new polluters to minimize their emissions." *Nat'l Parks Conservation Ass'n, Inc. v. Tenn. Valley Auth.*, 480 F.3d 410, 412 (6th Cir. 2007). Thus, in 1977, Congress amended the CAA to include the "New Source Review" program (the "NSR"). *Id.* The NSR included a PSD control scheme, which was intended to provide additional protection for air quality in certain parts of the country "notwithstanding attainment and maintenance of all national ambient air quality standards." 42 U.S.C. § 7470(1); *Duke Energy Corp.*, 549 U.S. at 567-68.

Under the PSD control scheme, each SIP must "contain emission limitations and such other measures as may be necessary . . . to prevent significant deterioration of air quality in each region (or portion thereof) designated pursuant to [§] 7407." 42 U.S.C. § 7471. PSD permits are also needed before a "major emitting facility" can be constructed. *Id.* § 7475(a). The term "construction" includes the "modification . . . of any source or facility" as defined in § 7411(a). *Id.* § 7479(2)(C). "Modification," in turn, means "any physical change in, or change in the method of operation of, a stationary source which increases the amount of any air pollutant emitted by such source or which results in the emission of any air pollutant not previously emitted." *Id.* § 7411(a)(4).

In addition to the applicable federal regulations, Tennessee has implemented its own PSD regulations in the form of the TAPCR. TAPCR § 1200-3-9-.01(1) provides that:

> No person shall begin the construction of a new air contaminant source or the modification of an air contaminant source which may result in the discharge of air contaminants without first having applied for and received . . . a construction permit for the construction or modification of such air contaminant source.

TAPCR § 1200-3-9-.04(4)(a)(2) provides further, however, that these requirements "shall only apply to a proposed major stationary source, or major modification with respect to any pollutant which is emitted in significant amounts, or would result in a significant net emissions increase of the pollutant respectively." A "major modification" is defined in the TAPCR as "any physical change in or change in the method of operation of a major stationary source that would result in a significant net emissions increase of any pollutant subject to regulation under" the Tennessee division of air pollution control. *Id.* § 1200-3-9-.01(4)(b)(2). Both parts of the "major modification" definition–physical change, and a resulting increase in emissions–must be satisfied before a project will be considered a "major modification," and will thus be subject to the permit requirements of the TAPCR.

B. Routine Maintenance, Repair, and Replacement

Critical to this case is the statutory and regulatory exception for "routine maintenance, repair, and replacement." TAPCR § 1200-3-9-.01(4)(b)(2)(i)(I) provides that a "physical change or change in the method of operation shall not include . . . [r]outine maintenance, repair, and replacement." Plaintiffs contend that the 1988 economizer and superheater projects constitute "major modifications" of Bull Run. They contend further that, as a result, TVA is liable for failing to comply with the PSD requirements applicable to such major modifications. TVA contends that it is not liable in this case because the 1988 projects did not amount to "major modifications" of Bull Run. TVA first contends that no physical change occurred at Bull Run as a result of the 1988 projects, because these projects constituted "routine maintenance, repair, and replacement." TVA next contends that, even if a physical change occurred as a result of the 1988 projects, no significant net emissions increase resulted from that physical change.

TVA bears the burden of proving that the 1988 projects do not constitute a "major modification" because they fall within the "routine maintenance, repair, and replacement" exception [*see* Doc. 170]. In determining whether this exception applies, the Court considers four central factors: (1) the nature and extent of the projects; (2) the purpose of the projects; (3) the frequency of the projects; and (4) the cost of the projects. *Wis. Elec. Power Co. v. Reilly*, 893 F.2d 901, 910 (7th Cir. 1990) ("*WEPCo*"). No single factor is dispositive.

United States v. Cinergy Corp., 495 F. Supp. 2d 892, 901 (S.D. Ind. 2007). The Court answers the question of whether these projects are "routine" within the meaning of the exclusion above by examining projects in both the industry as a whole and at Bull Run in particular. *United States v. S. Ind. Gas & Elec. Co.*, 245 F. Supp. 2d 994, 1016 (S.D. Ind. 2003) ("*SIGECo*") ("*WEPCo* supports the view that the frequency of the project at the particular unit and the frequency of the project within industry are *both* relevant considerations."). *See also* Doc. 170, at 17-18 (summary judgment order) (quoting *United States v. E. Ky. Power Coop., Inc.*, 498 F. Supp. 2d 976, 993-94 (E.D. Ky. 2007)) ("[T]he Court is persuaded by the reasoning of those courts that have adopted the 'routine in the industry' standard . . . [but] emphasizes that comparison with others in the industry is just one of a number of factors considered in the RMRR analysis. In other words . . . 'the Court will . . . tak[e] into consideration the work conducted at the particular . . . unit, the work conducted by others in the industry, and the work conducted at other individual units within the industry.'").

The Court examines each of these factors below. Such examination requires "a fact-intensive, case-by-case determination" that yields a "common-sense finding." *WEPCo,* 893 F.2d at 910; *SIGECo,* 245 F. Supp. 2d at 999. For the reasons that follow, the Court finds that both projects fall within the routine maintenance, repair, and replacement exception.

1. Economizer Replacement

The Court first considers these factors as they relate to the economizer replacement.

a. Nature and Extent

The Court finds the nature and extent of the economizer replacement to be somewhat significant. The project amounted to the removal and replacement of all of the economizer tube elements in both furnaces at Bull Run. This removal and replacement required cutting a number of holes in the walls of Bull Run's furnaces, and necessitated the use of cranes, monorails, and an extensive rigging system [Doc. 203, at 69-79 (Hekking Testimony)]. TVA had to hire a large number of outside craftsmen and laborers to complete the project [Doc. 203, at 81-82 (Hekking Testimony)]. The project also required the approval of the TVA Board of Directors.

As Mr. Hekking conceded on cross-examination, however, some of the projects listed on Bull Run's "furnace rehabilitation history" would have required the same rigging and material handling structures as the economizer project [Doc. 203, at 153 (Hekking Testimony)]. Some of these projects would have also required that TVA hire a large number of outside craftsmen and laborers to complete them [Doc. 203, at 153 (Hekking Testimony)]. Some would have involved multi-year planning [Doc. 203, at 153 (Hekking Testimony)]. And some would have required authorization from the TVA Board of Directors [Doc. 203, at 153-54 (Hekking Testimony)].[15]

---

[15] Mr. Hekking also conceded that a project requiring approval beyond plant management could still be considered "routine" [Doc. 203, at 159-60 (Hekking Testimony)].

The costs charged to the economizer project were classified as capital improvements by TVA. But it would have been inconsistent with the accounting rules followed by TVA to treat the costs for the economizer project as maintenance expenses chargeable to TVA's operating budget. It would also have been inconsistent with the Uniform System of Accounts established by FERC to treat the costs for this project as operating and maintenance expenses.

Moreover, TVA performed more than 2,000 capital projects at its eleven coal-fired power plants between 1969 and 1988 that each exceeded $100,000 in cost [Doc. 201, at 41-42 (Golden Testimony)]. Many of these projects were capitalized [Def.'s Exs. 60, 61]. Replacing an economizer, in other words, is not a small task, but it is also not an extraordinary task. The nature and extent factor thus favors TVA.

b. Purpose

The Court finds that the purpose of the economizer replacement project was to reduce the number of forced outages related to economizer tube leaks. TVA discovered conditions in the economizer that TVA believed would threaten the continued efficient operation of Bull Run [Doc. 204, at 248 (Golden Testimony)]. TVA believed that replacing the economizer would reduce or eliminate forced outages related to economizer tube leaks, and would thereby improve the availability and/or reliability of Bull Run [Doc. 204, at 248-49 (Golden Testimony)].

The Court recognizes that, in the five years preceding the economizer replacement project, there were no outages lasting longer than a few days that were attributable to leaks or to other failures of the economizer [Doc. 204, at 8 (Koppe Testimony)]. The Court also recognizes that Bull Run did not suffer any downtime as a result of economizer tube leaks in the fifteen months that preceded the 1988 outage [Doc. 204, at 86 (Koppe Testimony)]. But TVA knew that the economizer tubes were "heavily damaged in some areas" [Def.'s Ex. 16, at 1]. And TVA expected that, as a result of this damage, the rate of economizer tube failures would "rapidly increase until all elements in the economizer c[ould] be replaced" [Def.'s Ex. 18, at 1].

The Court also finds that TVA expected the economizer replacement to extend the life of this section of Bull Run by approximately twenty years [Doc. 203, at 106 (Hekking Testimony)]. The Court, however, does not consider this finding to weigh against TVA. The economizer replacement was undertaken after TVA determined that the benefit of replacing the economizer outweighed the costs of continuing to operate with that economizer [Doc. 204, at 248-49 (Golden Testimony); Def.'s Ex. 18, at 1]. Any "life extension" effected as a result of the economizer replacement was thus a byproduct of, rather than the primary purpose of, that replacement. The purpose factor thus favors TVA.

c. Frequency

The Court finds economizer replacements to be common in the industry. Mr. Golden testified that, in a survey of 219 units, 202 of which were equipped with economizers, 98 had undergone some economizer replacement activity as of the year 2000 [Doc. 201, at 69 (Golden Testimony); Def.'s Ex. 37, at 37-38]. Also, Mr. Koppe testified that "quite a few" of the coal-fired power plants like Bull Run that were built in the 1960s and 1970s had replaced their economizers by the 1980s [Doc. 204, at 104-05 (Koppe Testimony)].

The Court also finds that it was not unusual for Bull Run to have replaced its economizer when it did. According to the survey just referenced, the average life of an economizer at the time of its replacement was 23 years [Doc. 201, at 69-70 (Golden Testimony); Def.'s Ex. 37, at 38]. The economizer at Bull Run was replaced at 21 years. Discussions during the meeting of the TVA Board of Directors at which the economizer project was approved indicated that "most" other plants of the same vintage as Bull Run had already replaced their economizers by that time.

The Court is not persuaded by the testimony of Mr. Hekking to the contrary. Mr. Hekking testified that Bull Run was the only plant in the country that he was "aware of" that has had more than one economizer replacement [Doc. 203, at 116-17 (Hekking Testimony)]. He concluded that an event occurring once every twenty years could not be considered "frequent," and that the economizer replacement at Bull Run could not be considered frequent for that reason [Doc. 203, at 117-19 (Hekking Testimony)].

Mr. Hekking's testimony amounts to an extrapolation across an entire industry of his knowledge of activity at one unit. It further overemphasizes the significance of the number of times a particular type of element is replaced at a single plant, as opposed to the frequency with which such an element is replaced at units across the industry. *See Duke Energy Corp.*, 278 F. Supp. 2d at 634 ("If the relevant inquiry under the RMRR exemption is whether a particular activity is 'routinely performed at an individual unit' . . . the EPA in WEPCO could have simply concluded its RMRR inquiry with the admission by WEPCO that the proposed project would occur only once or twice during a unit's expected life cycle."). Mr. Hekking's opinion, finally, is not based upon objective data drawn from examples across the industry. Nor is the Court persuaded by plaintiffs' challenge to the objective data reflected in the industry survey relied upon by Mr. Golden. Other courts have relied upon this same survey. *See, e.g.*, *Cinergy Corp.*, 495 F. Supp. 2d at 912. Also, the EPA relied upon this report in a formal briefing to the President of the United States on NSR [Def.'s Ex. 40, at 12]. The frequency factor favors TVA as well.

d. Cost

The Court finds that the cost for the economizer replacement was not uncommonly high. The cost of the economizer replacement as approved in 1985 was $8,791,000.00 [Doc. 203, at 44 (Hekking Testimony); Def.'s Ex. 18, at 1]. The actual cost of the economizer replacement was $6,456,599.14 in 1988 dollars. But in the period from 1969 to 1998, TVA performed 120 capital projects at its coal-fired plants that were more expensive than the economizer replacement, as judged by its actual cost [Doc. 204, at 232-33 (Golden Testimony)]. During that same time period, TVA performed several capital projects at Bull Run that were also more expensive than the actual cost of the economizer replacement project [Def.'s Ex. 60, at 5-7]. The cost of this project was a small fraction of TVA's $300 million annual capital budget [Doc. 203, at 181-82 (Hekking Testimony)].

The Court is not persuaded by plaintiffs' comparison of the cost of this project to Bull Run's maintenance budget. Undoubtedly, were this project classified as a maintenance expenditure, it would be on the high end of that classification. But this project was classified as a capital expenditure. The relevant consideration is thus to other capital projects. As compared with that category of project, the economizer replacement is unremarkable. The cost factor thus favors TVA as well.

For these reasons, the Court finds that the economizer replacement project is properly categorized as routine maintenance, repair, and replacement.

2. Superheater Replacement

The Court now considers these factors as they relate to the superheater replacement.

a. Nature and Extent

The Court finds that the nature and extent of the superheater replacement was somewhat significant. The project amounted to the replacement of approximately three-quarters of the tubing in the finishing superheater at Bull Run, totaling more than 58,000 feet [Doc. 204, at 69 (Koppe Testimony)]. Like the economizer project, the superheater project required cutting a number of holes in the walls of Bull Run's furnaces, and necessitated the use of cranes, monorails, and an extensive rigging system [Doc. 203, at 69-79 (Hekking Testimony)]. TVA also had to hire a large number of outside craftsmen and laborers to complete the project [Doc. 203, at 81-82 (Hekking Testimony)].

As Mr. Hekking conceded on cross-examination, however, some of the projects listed on Bull Run's "furnace rehabilitation history" would have required the same rigging and material handling structures as the superheater project [Doc. 203, at 153 (Hekking Testimony)]. Some of these projects would have also required that TVA hire a large number of outside craftsmen and laborers to complete them [Doc. 203, at 153 (Hekking Testimony)]. Some would have involved multi-year planning [Doc. 203, at 153 (Hekking Testimony)]. And some would have required authorization from the TVA Board of Directors [Doc. 203, at 153-54 (Hekking Testimony)].

The superheater project did involve replacing the existing tube material with a different type of tube material [Doc. 203, at 57 (Hekking Testimony); P.'s Ex. 129, at 1]. But this is not surprising: the original T-22 metal in the secondary superheater was operating above design limits, and the failures occurring in the superheater were the result of long term overstress due to elevated temperatures in that section of the boiler [Doc. 204, at 239 (Golden Testimony); Def.'s Ex. 27]. As Mr. Golden testified, replacing a component, or a portion of a component, at a unit sometimes involves considering whether a better product is available that performs the same function [Doc. 201, at 44 (Golden Testimony)]. That was the case here.

The superheater replacement was approved in the summer of 1987. TVA originally admitted in its response to a request for admissions propounded by plaintiffs that TVA's Board of Directors approved the superheater project [P.'s Ex. 4, ¶ 67]. TVA later averred that, "during the course of the litigation, TVA has diligently searched for and been unable to locate any . . . record indicating that the 1988 Bull Run superheater project was ever presented to or approved by its Board of Directors" [Doc. 186]. TVA requested permission from this Court to withdraw its admission on this issue. The Court granted that request after trial [*see* Doc. 222].

The Court finds that, although no records have been located documenting the approval of this project by TVA's Board of Directors, the superheater replacement project nevertheless involved the sort of capital outlay that would ordinarily require Board approval to proceed. As the Court has already explained with reference to the economizer replacement project, however, the fact that Board approval would be required for a project does not automatically disqualify that project from being RMRR: as Mr. Hekking conceded, a project requiring approval beyond plant management could still be considered "routine" [Doc. 203, at 160 (Hekking Testimony)]. Thus, by the admission of plaintiffs' own expert, the question of whether a project requires the approval of the board of directors is not dispositive of the ultimate question of whether the RMRR exception applies.

As with the economizer replacement project, the costs charged to the economizer project were classified as capital improvements by TVA. However, it would have been inconsistent with the accounting rules followed by TVA to treat the costs for the superheater project as maintenance expenses chargeable to TVA's operating budget. It would also have been inconsistent with the Uniform System of Accounts established by FERC to treat the costs for the superheater project as operating and maintenance expenses.

Moreover, TVA performed more than 2,000 capital projects at its eleven coal-fired plants between 1969 and 1988 that each exceeded $100,000 in cost [Doc. 201, at 41-42 (Golden Testimony)]. Many of these projects were capitalized [Def.'s Exs. 60, 61]. Replacing a secondary superheater, in other words, is not a small task; but it is also not an extraordinary task. The nature and extent factor thus favors TVA.

b. Purpose

The Court finds that the purpose of the superheater replacement project was to reduce the number of forced outages related to superheater tube leaks. TVA believed that replacement of these elements in the secondary superheater would "reduce the number of forced outages, [and] increase the availability and reliability of the unit" [Doc. 203, at 57 (Hekking Testimony); P.'s Ex. 129, at 1]. The Court notes that five tube failures occurred in the T-22 tubing in this section of the superheater in the twenty-four months prior to September 29, 1981 [Def.'s Ex. 27].

The purpose of the superheater replacement was not to alter fundamentally this piece of equipment at the Bull Run plant. The superheater replacement did not increase the generating capacity of the Bull Run plant on either a continuous basis or a peaking basis. Nor did the replacement make the unit physically bigger. Nor, finally, did the replacement increase the maximum hourly emissions capability of the unit for either sulfur dioxide or nitrogen oxides.

When it conducted the superheater replacement, TVA did replace the T-22 metal in the superheater with TP-347H metal [Doc. 203, at 57 (Hekking Testimony); P.'s Ex. 129, at 1]. But this is not surprising: design inadequacies in T-22 metal were one of the most common causes of superheater failure in the industry at the time [Doc. 204, at 237-38 (Golden Testimony)]. The T-22 metal in the superheater at Bull Run was operating above design limits, and TVA expected that replacing the T-22 metal with TP-347H metal would prevent superheater failures in the future [Doc. 203, at 57 (Hekking Testimony); P.'s Ex. 129, at 1; Def.'s Ex. 27].

TVA also expected that the superheater replacement would "extend the life of this section of the boiler by approximately 20 years" [Doc. 203, at 57 (Hekking Testimony)]. This is also not surprising. Nor does this finding weigh against TVA. The superheater replacement was undertaken after TVA determined that the benefit of replacing the superheater outweighed the costs of continuing to operate Bull Run with that superheater [Doc. 204, at 248-49 (Golden Testimony)]. Any "life extension" effected as a result of the superheater replacement was thus a byproduct of, rather than the primary purpose of, that replacement. The purpose factor thus favors TVA.

c. Frequency

The Court finds superheater replacements to be common in the industry. Over the past thirty or forty years, a "fairly substantial fraction" of the coal-fired units in the industry have replaced at least some portion of their superheater [Doc. 204, at 105 (Koppe Testimony)]. A survey of 219 units in the industry found that there had been 293 full or partial replacements of superheaters that were capitalized and cost more than $100,000 [Doc. 201, at 77 (Golden Testimony)]. TVA records demonstrate that TVA had performed 123 partial or complete superheater replacement projects throughout its 59-unit system as of the year 2000 [Doc. 201, at 77-78 (Golden Testimony)]. It is not clear how many of these projects were performed prior to 1988, or how many were performed after 1988 [Doc. 208, at 78 (Golden Testimony)]. Nor is it clear how many of these projects were partial replacements, and how many were complete replacements [Doc. 208, at 78-79 (Golden Testimony)].

TVA's 1983 Retirement Plan Report does indicate, however, that eighteen superheater replacement projects had been performed within the TVA system as of 1979 [Def.'s Ex. 44, at 77]. It is not clear from that report which of those projects is comparable to the superheater replacement in this case. The 1988 secondary superheater replacement project represented the first time that the secondary superheater outlet pendants had been replaced at Bull Run [Doc. 203, at 113, 186 (Hekking Testimony)]. The outlet pendant tubes were again replaced in 2008 [Doc. 204, at 247 (Golden Testimony)]. The Court is convinced by this evidence that superheater replacements are common in the industry.

The Court is not persuaded by the testimony of Mr. Hekking to the contrary. Mr. Hekking testified that he did not know of any generating unit in the country that had replaced its superheater section twice or more [Doc. 203, at 117-18 (Hekking Testimony)]. But he conceded that the "likelihood that there are utilities out there that have replaced [their superheater] more than once would be higher than the economizer" [Doc. 203, at 118 (Hekking Testimony)]. He concluded that an event occurring once every twenty years could not be considered "frequent," and that the superheater replacement at Bull Run could not be considered frequent for that reason [Doc. 203, at 117-19 (Hekking Testimony)].

As with Mr. Hekking's testimony as to the frequency of the economizer replacement at Bull Run, this testimony amounts to an extrapolation across an entire industry of Mr. Hekking's knowledge of activity at one unit. It also overemphasizes the significance of the number of times a particular type of element is replaced at a single plant, as opposed to the frequency with which such an element is replaced at units across the industry. Further, it is not based upon objective data drawn from examples across the industry.

Moreover, Mr. Hekking acknowledged on cross-examination that superheater replacements were common among plants in the thirty-year age range [Doc. 203, at 147-48 (Hekking Testimony)]. He acknowledged further that he testified previously in an NSR enforcement action that "from my perspective and years of involvement in this industry it's pretty much a given that . . . superheaters are repaired and replaced" [Doc. 203, at 145-47 (Hekking Testimony)]. Such testimony suggests that superheater replacements like the one at issue were not as uncommon in the industry as Mr. Hekking originally suggested.

Nor is the Court persuaded by plaintiffs' challenge to the objective data reflected in the industry survey relied upon by Mr. Golden, for the reasons already stated. *See* discussion *supra* Part IV.B.1.c. The frequency factor thus favors TVA as well.

d. Cost

The Court finds that the cost for the superheater replacement was not uncommonly high. The cost of the partial superheater replacement project was estimated in 1987 at $3,177,000.00 [Doc. 203, at 61 (Hekking Testimony); P.'s Ex. 129, at 1]. The actual cost of the partial superheater replacement project was $1,846,680.59 in 1988 dollars. But in the period from 1969 to 1998, TVA performed 421 capital projects at its coal-fired power plants that were more expensive than the superheater replacement, as judged by its actual cost [Doc. 204, at 245 (Golden Testimony)]. During that same time period, TVA performed twenty-two capital projects at Bull Run that were also more expensive than the actual cost of the superheater replacement project [Doc. 204, at 245 (Golden Testimony)]. The cost of this project was a small fraction of TVA's $300 million annual capital budget [Doc. 203, at 181-82 (Hekking Testimony)].

The Court is not persuaded by plaintiffs' comparison of the cost of this project to Bull Run's maintenance budget. Undoubtedly, were this project classified as a maintenance expenditure, it would be on the high end of that classification. This project, however, was classified as a capital expenditure. The relevant consideration is thus to other capital projects. As compared with that category of project, the superheater replacement is unremarkable. Indeed, Mr. Golden testified that he examined a number of superheater replacement projects across the industry, and the cost of the Bull Run superheater project was at the low end of that range [Doc. 204, at 246-47 (Golden Testimony)]. The cost factor thus favors TVA as well.

For these reasons, the Court finds that the superheater replacement project is properly categorized as routine maintenance, repair, and replacement.

C. WEPCo Project and Beckjord Project[16]

The Court notes that neither the WEPCo project nor the Beckjord project weighs heavily in its determination as to whether the Bull Run projects were RMRR. With respect to the WEPCo project, the Court pointed out in its memorandum opinion on summary judgment in this case that the *WEPCo* court described the WEPCo project as a "highly unusual, if not unprecedented, and costly project." *WEPCo*, 893 F.2d at 911 (citing Clay Memorandum at 4). The *WEPCo* court noted further that the "EPA did not find[] even a single instance of renovation work at any electric utility generating station that approached the [WEPCo] life extension project in nature, scope or extent." *Id.*

Other courts have affirmed the uniqueness of the WEPCo project. As explained by the district court in *SIGECo*:

> [N]othing in *WEPCo* suggests that any project smaller than [the] WEPCo [projects] will automatically qualify as routine maintenance, or that [the] WEPCo [projects were] some type of baseline for companies to compare its projects to in efforts to determine if they would qualify for routine maintenance. Rather, *WEPCo* was an easy case on routine maintenance–the EPA and the Seventh Circuit quickly disposed of the defendant's arguments that it qualified for routine maintenance. . . . [T]he EPA never indicated that [the] WEPCo [projects were] a measuring stick for routine maintenance.

---

[16] The WEPCo project involved the "extensive renovation" of five units at WEPCo's Port Washington electric power plant. *WEPCo*, 893 F.2d at 905. Similarly, the Beckjord project, undertaken at Unit Three of Cincinnati Gas & Electric Company's ("CG&E's") Beckjord Station electric power plant, resulted in "modifications or replacements of approximately forty-nine components"; amounted to a "complete overhaul" of the unit; cost $16.3 million to perform; took thirteen weeks to complete; and was touted by CG&E as "the first complete renovation of an electric generating unit in the U.S." *Cinergy Corp.*, 495 F. Supp. 2d at 916-17. Experts for both parties in this case testified at trial about these two projects. *See, e.g.*, Doc. 201, at 17-21, 82-84 (Golden Testimony); Doc. 203, at 165 (Hekking Testimony).

SIGECo, 245 F. Supp. 2d at 1017. *See also United States v. Ohio Edison Co.*, 276 F. Supp. 2d 829, 860 (S.D. Ohio 2003) (quoting *SIGECo*, 245 F. Supp. 2d at 1017); *Duke Energy Corp.*, 278 F. Supp. 2d at 633 (citing EPA finding). In other words, the fact that the WEPCo projects were not RMRR does not substantially inform the analysis in this case of whether the Bull Run projects were RMRR.

Nor does the Beckjord project weigh heavily in this Court's determination as to whether the Bull Run projects were RMRR. Mr. Golden testified that Beckjord "involved 49 different projects, including replacement of two separate reheaters, a superheater, [and] three high-temperature headers during a single outage" [Doc. 201, at 88 (Golden Testimony)]. The purpose of the Beckjord project was to "add approximately 25 years to the overall unit life" [Doc. 201, at 88 (Golden Testimony)]. Mr. Golden testified that he compared the Beckjord project to the Bull Run project because "Beckjord Unit Three was a life extension project that was known to EPA, was investigated by EPA, and for which EPA found no violation" [Doc. 201, at 86 (Golden Testimony)].

The Court declined at trial to consider Mr. Golden's testimony "to the extent he's reaching any conclusions about what EPA found"; the Court, in other words, declined to draw from Mr. Golden's testimony any conclusions as to why or whether the EPA "found no violation" [Doc. 201, at 86-87]. Moreover, and as counsel for plaintiffs pointed out on cross-examination, the court in *Cinergy Corp.* found on summary judgment that the Beckjord Unit Three project was in fact not routine, and that "the RMRR exclusion d[id] not apply to th[at] project" [Doc. 208, at 25-27]. *Cinergy Corp.*, 495 F. Supp. 2d at 933-37. In contrast to the Bull Run projects, however, the Unit Three project "was a complete renovation project intended to extend the Unit's life," and involved "extensive remodeling" amounting to a "complete overhaul" of the unit. *Id.* at 934. The *Cinergy Corp.* court characterized the scope of the Unit Three project as "massive." *Id.* at 933. The project also cost more than 2.5 times as much as the economizer project in this case, and nearly nine times as much as the superheater project. *Id.* at 916. Thus, for similar reasons as those just given with respect to the WEPCo projects, the discussion of the Beckjord Unit Three project does not substantially inform the analysis in this case of whether the Bull Run projects were RMRR.

D. *Ohio Edison*

The Court also finds it helpful and important to explain the difference between this case and *United States v. Ohio Edison Co.*, 276 F. Supp. 2d 829 (S.D. Ohio 2003), a decision rendered after a bench trial in another district court in the Sixth Circuit that addressed similar issues as those in this case. In *Ohio Edison*, plaintiffs United States of America, along with the States of Connecticut, New Jersey, and New York, brought suit against defendant Ohio Edison Company, an energy producer. *Id.* at 832. Plaintiffs alleged that defendant's undertaking of eleven construction projects at seven different electric generating units at an Ohio Edison plant, costing approximately $136.4 million, triggered the application of the standards set forth in the 1977 amendments to the CAA. *Id.* at 832-34. These projects included the replacement of furnace waterwall tubes; economizer, superheater, and reheater tubes; burners; coal pipes; pulverizers; and low pressure turbine rotors. *Id.* at 840.

The court in *Ohio Edison* held in its opinion following trial that these activities did not constitute routine maintenance, repair, and replacement, and did result in a significant net emissions increase within the meaning of 40 C.F.R. § 52.21(b)(2)(i). *Id.* at 889-90. In doing so, the court determined that each of the *WEPCo* factors weighed in favor of plaintiffs. This Court examines the reasons why, and the differences between that case and this case, below.

1. Nature and Extent

The *Ohio Edison* court found the nature and extent of the activities it examined to be "large," because performance of the work required that each unit be shut down for weeks or months at a time; because the "unprecedented" work related to Unit 5 involved the installation of a "one-of-a-kind spiral tube furnace"; because the work orders stated that each of these activities "was undertaken with the goal of reducing forced outages and improving availability and reliability of the unit(s)"; because the work was performed by outside contractors; because approval of these projects was handled by defendant's central staff, and not by plant management; because all of these projects were funded using defendant's capital improvements budget; and because all of these projects were capitalized for accounting purposes. *Id.* at 858-59.

There is no question that many of these projects share the same characteristics as the Bull Run projects. In this Court's opinion, however, facts like those cited by the *Ohio Edison* court must be placed in their proper context. Shutting down a unit, even for a number of weeks, in order to work on the unit is a regular occurrence in the utility industry. So is hiring outside contractors to perform that work, seeking and obtaining approval beyond plant management for that work, and capitalizing the costs associated with that work. Nor is it remarkable that a project would be undertaken at a unit "with the goal of reducing forced outages and improving availability and reliability of the unit." *Id.* at 858. Such a goal might be set for even the most mundane repair work at a plant. The Court is thus not persuaded that facts like these compel the conclusion that a project falls outside the scope of the RMRR exception.[17]

2. Purpose

The *Ohio Edison* court found that the purpose of the activities at these units was not merely to maintain the units, but rather to "extend the lives of the units and make them more available and reliable well into the future." *Id.* at 860. The Court does not disagree that the purpose of the economizer and superheater projects in the present case was to improve the reliability and availability of these components at Bull Run. Yet this Court believes that the work performed at Bull Run during the 1988 outage was primarily designed to fix a problem–namely, to reduce forced outages resulting from boiler tube leaks in the economizer and secondary superheater. Improvements in availability and reliability at the plant could be expected to result from that work, but a belief that improvements like these would accrue from such work will not automatically transform that work into a major modification for PSD

[17] The Court notes further the factual differences between some of these projects and the projects at issue in the instant case. All but one of the *Ohio Edison* projects took longer to complete than the Bull Run projects. Most were more expensive than the economizer project at Bull Run. All but one were more expensive than the superheater project. In some cases, the Ohio Edison projects were considerably more expensive than either of the Bull Run projects. And unlike the installation of the spiral tube furnace in *Ohio Edison*, none of the Bull Run projects could be classified as "one-of-a-kind." *Ohio Edison*, 276 F. Supp. 2d at 858.

purposes. As the Court just explained with respect to the nature and extent factor, availability and reliability improvements could be expected from most projects undertaken to fix problems that arise at power plants, including minor projects that would unquestionably fall into the category of routine maintenance. The Court is thus similarly unpersuaded that facts like these compel the conclusion that a project falls outside the RMRR exception.

3. Frequency

The *Ohio Edison* court found that projects like those at issue in the case were performed infrequently. In considering the frequency issue, the *Ohio Edison* court held that "focus on the industry as a whole is not necessarily dispositive of whether the activity constitutes 'routine maintenance.'" *Id.* at 861. It held further that "[w]hether an activity can be considered 'routine maintenance, repair or replacement' is more appropriately judged by how frequently the activity has been performed at the particular unit at issue." *Id.*[18] Applying this standard to the fact that "almost all of the major component and equipment replacements [in the case] had never been performed before on the particular unit," and to the fact that "the projects were considered once or twice in a unit's lifetime," the court found that the frequency factor weighed against defendant as well. *Id.*

[18] The court de-emphasized consideration of the routineness of a particular type of project across the industry, finding that courts "certainly c[ould] take into account repairs done at other plants across the country," but ultimately concluding that "such evidence is not as instructive in addressing whether a particular activity at a particular unit can be considered routine." *Id.*

For the reasons set forth in the Court's memorandum opinion on summary judgment in this case and in this opinion, the Court applies a somewhat different standard to the frequency analysis. This Court answers the question of whether a project at a particular unit is "routine" by asking how frequently that type of project is done within the industry, as well as how frequently the project is performed at the particular unit [Doc. 170]. *See also Duke Energy Corp.*, 278 F. Supp. 2d at 634 ("If the relevant inquiry under the RMRR exemption is whether a particular activity is 'routinely performed at an individual unit' . . . the EPA in WEPCO could have simply concluded its RMRR inquiry with the admission by WEPCO that the proposed project would occur only once or twice during a unit's expected life cycle."). In applying this standard to the objective data on economizer and superheater replacements offered in this case, the Court has no difficulty finding that such replacements are routine at TVA and throughout the industry. The Court is not overly persuaded by the fact that the projects at issue are performed relatively infrequently at the units themselves, particularly given the Court's finding of economizer and superheater replacements to be common in the industry and the frequency with which such elements have been replaced at units across the industry.

4. Cost

Finally, the *Ohio Edison* court found the cost of the projects to be significant. *Id.* The court also found it significant that the costs incurred in performing the projects were capitalized, and were not budgeted as maintenance expenses. *Id.* at 862. As with the nature and extent factor, there is no question that many of these individual projects share the same cost characteristics as the Bull Run projects, although many were more expensive than the Bull Run projects. But again, as with the facts set forth in the *Ohio Edison* court's treatment of the nature and extent factor, facts like those cited by the *Ohio Edison* court must be placed in their proper context. TVA performed 120 capital projects at its coal-fired power plants in the period from 1969 to 1998 that were more expensive than the economizer replacement project, as judged by its actual cost, including several projects at Bull Run. Similarly, TVA performed 421 capital projects at its coal-fired power plants in the period from 1969 to 1998 that were more expensive than the superheater replacement at Bull Run, as judged by its actual cost, including twenty-two capital projects at Bull Run. The actual cost of these two projects was a small fraction of TVA's $300 million annual capital budget. Viewed in this light, the Court does not believe the costs associated with the projects in this case weigh against a finding of RMRR.

V. Conclusion

For the reasons above, the Court finds that the projects in this case fall within the routine maintenance, repair, and replacement exception to the major modification requirements of the PSD regulations. The Court will therefore enter judgment for TVA.

An order reflecting this opinion will be entered.

s/ Thomas A. Varlan
UNITED STATES DISTRICT JUDGE