EAST KENTUCKY POWER COOPERATIVE, INC. CASE NO. 2024-00310
FIRST REQUEST FOR INFORMATION RESPONSE

STAFF'S REQUEST DATED OCTOBER 28, 2024

REQUEST 6

RESPONSIBLE PARTY: Julia J. Tucker

Request 6. Refer to the Tucker Direct Testimony page 16 lines 11-23, page 17 lines 1-16, and Exhibit JJT-3. Provide the resource selection and resource optimization analyses complete with a detailed explanation of all the assumptions (including Environmental Protection Agency (EPA) and PJM related assumptions), and all potential resource (including power purchase agreements (PPAs) fixed and variable cost data used determine the specific resources selected and the timing of new resource implementation represented in Exhibit JJT-3.

Response 6. EKPC is anticipated to be capacity deficient beginning in the 2025/2026 winter peak period by 200 MWs, not accounting for any planning reserve margin, when comparing existing generation assets against forecasted peak load without the addition of new generation assets and/or PPAs. When the seven percent planning reserve margin is added to the peak load forecast the expected capacity deficiency increases from 200 MWs to 454 MWs in the 025/2026 winter peak period, as shown in Attachment JJT-3, the EKPC Capacity Expansion Plan, in columns P and Q, "Deficit before Cap Additions". This deficit is forecasted to grow from 454 MWs in 2025/2026 to 908 MWs in the 2038/2039 winter peak period.

In order for EKPC to meet this immediate capacity need it has only PPAs as alternatives, due to the time required to permit and construct a new facility. EKPC currently has a short-term PPA for energy from Safe Harbor Hydro and is in negotiations to extend that into a longer-term contract that will provide a bridge to installed capacity. While this PPA provides an energy bridge to the

RICE units, it does not provide dispatchable generation or capacity value. The hydro owners sell the energy, capacity and renewable energy credits each as a separate product, not bundled. EKPC did not choose to purchase the capacity and renewable energy credit products in its PPA, as they were not deemed to be economically prudent purchases.

EKPC's updated 2024 long term load forecast shows a significant increase in expected winter peak loads based on recent experience but it does not report significant changes in expected energy requirements. Therefore, EKPC's optimization analyses in its 2022 Integrated Resource Plan ("IRP") continues to be relevant concerning its energy resource needs going forward. That plan indicates that solar resources are economically viable for EKPC and that its next dispatchable resource is expected to be a combustion turbine. EKPC did not include RICE units in its alternatives in the 2022 IRP.

EKPC compared the RICE units to a simple cycle combustion turbine only in its analysis for this application, since the detailed optimization studies for the 2022 IRP were still pertinent with regards to energy needs. However, the timing of the need for the next resource has changed due to the change in peak load expectations.

The capital cost for an "F" class combustion turbine was assumed to be $1,329/kW, with a full load average heat rate of 9,717 btu/kWh. Fixed operations and maintenance ("O&M"") of $26/kW-yr and variable O&M of $6.94/MWh. The capital cost for the RICE engines was assumed to be $1,995/kW, with an average annual heat rate of 8,381 btu/kWh. Fixed O&M for RICE is $15/kW-yr and variable O&M is $2.65/MWh. A carrying charge rate of 10.8%, based on 4.5% interest and 30 years depreciation, results in annual fixed charges of $143,500/MW-yr for the combustion turbine and $215,500/MW-yr for the RICE units. Adding fixed O&M charges to the capital investment shows an annual cost of $169,500/MW-yr for CT and $230,500/MW-yr for RICE. RICE costs $61,000/MW-yr more than the CT in fixed charges. RICE units are more efficient and cost less to run on a variable cost basis than the CT. The crossover point between the two technologies is highly dependent on natural gas prices. At $4.00/mmbtu gas cost, the CT costs $38.87/MWh ($4.00/mmbtu * 9,717 btu/kWh * 1,000 kWh/MWh / 1,000,000 btu/mmbtu). The RICE unit costs $33.52/MWh ($4.00/mmbtu*8,381btu/kWh*1,000kWh/MWh/ 1,000,000btu/mmbtu). The total variable cost for a CT including variable O&M is $45.81/MWh. The total variable cost for a RICE unit is $36.17/MWh, which is $9.64/MWh less than the CT. Solving for the breakeven point between fixed cost versus variable cost savings shows a crossover point at 6,328 hours per year ($61,000/MW-yr / $9.64/MWh). A gas price of $3.00/mmbtu results in a cross over point of 7,350 hours per year and a gas price of $5.00/mmbtu results in a cross over point of 5,560 hours per year.

From a strict price point, the combustion turbine is slightly less in total cost. However, from a strategic point, the RICE units provide a tremendous amount of flexibility operationally and reduce the risk of performance penalties in the PJM capacity market.

The RICE units will receive as much capacity value, if not more, in the PJM capacity auction as the combustion turbine. The lower minimum operating level on the RICE units as compared to the combustion turbine mean that they will likely operate more often than the CT. The RICE units can follow load much better than the CT, meaning that the change in generation needs when there is substantial solar penetration on the system will be much better suited to the RICE units than the CT.

EKPC believes that PJM will see substantial solar penetration in its system, as will EKPC, and having the RICE units will provide significant benefit to the system. The flexibility of the RICE units will also help support the addition of solar generation to the system. RICE units have distinct advantages over CTs, including faster start times, quicker ramp rates, and lower minimum downtime and runtime values. These advantages make RICE units an attractive resource within the PJM energy market, as shown by the anticipated revenue as discussed within the Application. Building a resource and ensuring EKPC has steel in the ground provides EKPC with all attributes of a resource, including energy and capacity, at a competitive cost as compared to PPAs and enables EKPC to effectively hedge against PJM market risks such as capacity performance and high energy prices. RICE units also fully comply with current greenhouse gas regulations as more fully described in the direct testimony of Jerry Purvis.

Supplemental Response Please see the attached March 3, 2025 article, "Reciprocating Engine Technology Supports Grid Flexibility and Renewables Integration" by Aaron Larson. This article supports EKPC's position regarding the need for RICE to support the increased integration of solar and other intermittent resources onto the grid.

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Gas

Reciprocating Engine Technology Supports Grid Flexibility and Renewables Integration

Modern reciprocating engines are enabling reliable power generation while balancing renewable energy growth. Their rapid-response capabilities and multi-fuel flexibility are crucial to grid stability. Real-world applications and emerging sustainable fuel options demonstrate how this technology bridges current power needs with future environmental goals.

In an era where grid reliability and flexibility are paramount, reciprocating engine technology has emerged as a crucial component in modern power generation systems. These versatile engines, which operate on the same fundamental principles as automobile engines but on a much larger scale, provide unique advantages that complement the evolving needs of our electrical infrastructure. Their ability to start quickly, adjust output rapidly, and operate efficiently across varying loads makes them incredibly valuable assets in a grid increasingly dependent on intermittent renewable energy sources.

The integration of reciprocating engines into power plants (Figure 1) addresses several critical challenges facing today's electrical grid. Unlike larger combined cycle gas turbine (CCGT) plants that may take hours to reach full capacity, engines can achieve full power within minutes, providing essential backup during unexpected demand spikes or renewable energy shortfalls. This rapid-response capability, combined with their modular nature, allows power plant operators to precisely match generation to demand, improving overall system efficiency.

1. Heber Light and Power, a public power provider based in Heber City, Utah, operates a reciprocating engine power plant featuring Caterpillar technology. Courtesy: Caterpillar

Beyond their operational flexibility, reciprocating engines represent a bridge between traditional and future power generation paradigms. Their ability to run on various fuels, including natural gas, biogas, and hydrogen blends, positions them as adaptable assets in the transition toward cleaner energy sources. As utilities work to balance reliability with environmental responsibility, engines provide a practical solution that supports grid stability while accommodating the growing integration of renewable energy resources.

Engines Fill Multiple Roles

“The integration of intermittent renewable energy resources to the power grid is still a challenge for our customers,” Michael Fiedler, senior business development manager for the Power segment with MAN Energy Solutions, told *POWER*. “Here, our gas engine power plants are an ideal match to close the gaps in the energy supply by balancing the fluctuations caused by intermittent renewable energy resources. We are convinced that flexible and decentralized, gas-fired power plants will play a decisive role for a secure power supply on the pathway toward 100% renewable energy.”

Fiedler said an increasing number of combined heat and power (CHP) plants is already relying on gas engine technology. “Especially in Germany we are actually leading in gas-engine-powered CHP plants with numerous projects in cities such as Chemnitz, Frankfurt an der Oder, and Schäbisch-Hall. Especially in regard to the decision to phase-out coal in Germany, these gas-fired CHP plants will gain importance since they use resources more effectively—with high overall efficiencies of over 90%—and consequently emitting less CO_2,” he said.

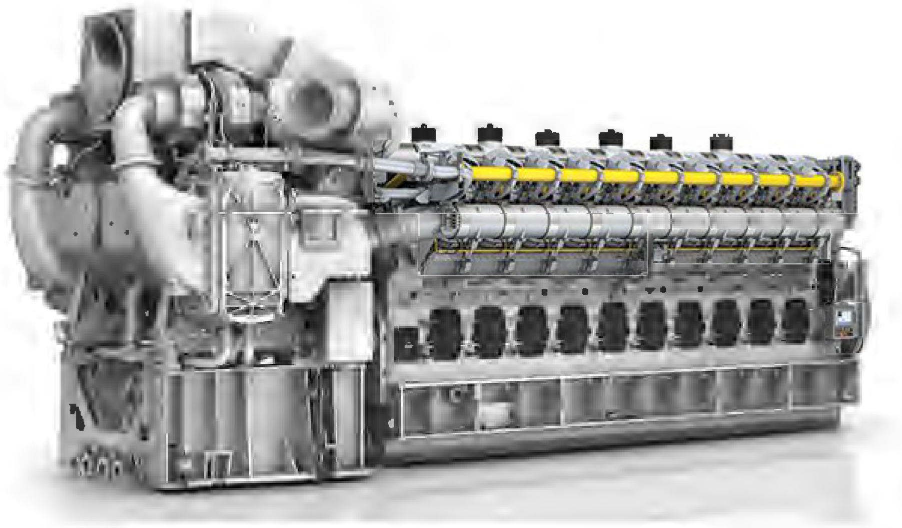
Gas engines are also an ideal match for the power requirements of data centers. These applications especially need a reliable and flexible power supply in order to ensure a very high availability. Further integration of renewable energies into the grid, leading to fluctuations in the power supply, can result in the requirement for a data center to temporarily reduce its power consumption from the grid. In these cases, a gas engine power plant can be ramped up and down quickly to compensate for fluctuations in the energy supply. By doing so, the use of renewable energy can be maximized at all times, keeping costs and the carbon footprint as low as possible while ensuring a reliable energy supply.

Meanwhile, a gas engine power plant is also an excellent option for non-grid-connected data centers. Engines are a proven and reliable technology that can provide the necessary flexibility for artificial intelligence (AI) data centers, which are expected to have a fluctuating load profile. Furthermore, if the data center gets a grid connection after-the-fact, the power plant can be used for providing grid services.

“For example, the U.S. is currently the country where the most data centers are being planned and built worldwide,” Fiedler said. “Data centers in the U.S. currently require about 25 GW of power generation capacities. It is estimated that this will rise to 47 GW by 2030. In order to meet this demand, the necessary investments in the energy supply are estimated at around $50 billion. Gas engine power plants play an important role here to secure the supply at any time of day and in any weather.”

Fuel Flexibility

Natural gas remains the primary fuel for most reciprocating engine power plants, offering relatively clean combustion and widespread availability through existing infrastructure (Figure 2). However, the true value of these engines lies in their ability to operate on multiple alternative fuels, often with minimal modifications. In addition to pipeline natural gas and liquefied natural gas (LNG), many engines can be designed to run on petroleum gas from oil production, biogas from landfills or wastewater treatment plants, synthetic gas from biomass gasification, propane as a backup fuel, crude oil and heavy fuel oil (HFO) in certain models, hydrogen blends (typically up to 25% hydrogen with natural gas), mine gas from coal operations, and field gas from oil and gas operations.



2. Four 20V35/44G TS gas engines with a total capacity of 48 MW were supplied by MAN Energy Solutions for a recently built power plant in the Indonesian city of Cicarang. Courtesy: MAN Energy Solutions

This fuel flexibility is crucial for several reasons. First, it provides energy security and reliability. If one fuel source becomes unavailable or cost-prohibitive, plants can switch to alternative fuels with minimal downtime. This is particularly valuable in regions with uncertain fuel supply chains or during natural disasters that might disrupt primary fuel delivery.

Second, it enables plants to take advantage of market opportunities. When prices fluctuate between different fuel types, operators can switch to the most economical option, helping to maintain competitive electricity prices for consumers. This ability to arbitrage between fuels can significantly impact a plant's operational economics.

Third, fuel flexibility supports environmental goals and regulatory compliance. As emissions regulations evolve, plants can transition to cleaner fuels without requiring complete equipment replacement. The ability to use renewable fuels like biogas or hydrogen blends also helps utilities meet renewable portfolio standards and reduce their carbon footprint.

Lastly, this versatility makes reciprocating engines particularly valuable in remote or island locations where fuel availability might be limited or inconsistent. Plants can be designed to run on whatever fuel sources are locally available, reducing dependence on imported fuels and enhancing energy independence.

"Our future-proof gas engines offer a clear path toward net zero," Fiedler said. "Already today, our gas engines can run on a variety of climate-neutral fuels such as biogas and synthetic natural gas (e-methane) derived from green hydrogen. Also, our 35/44G TS, 51/60G, and 51/60G TS gas engines are already 'H_2-ready' and can be operated with a hydrogen proportion of up to 25% by volume in the gas mixture. At the same time, we are working on future concepts that will enable hydrogen fueling of up to 100% as soon as hydrogen becomes available in large quantities."

Caterpillar is another engine provider that has expanded its line of gas generator sets capable of running on hydrogen fuel. Caterpillar now offers gas gensets ranging in power from 400 kW to 4.5 MW, each with the capability of blending natural gas with up to 25% hydrogen by volume.

Real-World Success Stories

Scala Data Centers, a Latin American platform of data centers in the hyperscale market, completed a "proof of concept" (POC) confirming the technical feasibility of using hydro-treated vegetable oil (HVO), also known as "green diesel," in its Caterpillar backup generators. Derived from renewable sources, green diesel undergoes a hydro-treatment process, transforming it into a high-quality fuel with reduced environmental impact. Replacing fossil diesel with HVO can decrease greenhouse gas emissions by up to 85%, according to Scala, which it said supports the company's commitment to sustainability. During the POC, conducted by Scala's Center of Excellence in Engineering in collaboration with its operations team and Sotreq, Caterpillar's dealer in Brazil, HVO demonstrated "excellent performance in backup generators, maintaining critical resilience of data centers without requiring changes to existing equipment," the company reported.

"We closely monitored Scala's test on Caterpillar equipment in a pioneering initiative in Latin America," Mauricio Garcia, director of Sotreq's Power Unit, said in a statement. "The use of HVO in generators opens up a universe of possibilities, in addition to ensuring lower maintenance costs, preserving equipment, and reducing greenhouse gas emissions."

However, HVO is three times more expensive than diesel fuel at the present time in Latin America. Therefore, the widespread implementation of HVO in Scala's operations is not expected immediately. "We closely monitor market trends, hoping to identify opportunities that could make the use of HVO economically viable on a larger scale," the company said. "We anticipate that movements like ours will raise awareness within the supply chain about the substantial demand potential for HVO, prompting stakeholders to explore more attractive commercial terms conducive to its widespread adoption."

In the U.S., more than 8 million gallons of HVO has been used to generate power by customers using Cat rental power solutions supplied by Peterson Power Systems, the local Cat dealer for electric power in northern California, Oregon, and southwest Washington. The Cat rental power solutions using HVO fuel have been predominantly used by utilities to supply energy around the clock during public safety power shutoffs and after wildfires damaged grid transmission lines in northern California. In Norway, STACK Infrastructure, a global developer and operator of data centers, implemented the use of HVO100—the purest form of HVO—as a standby power source for a new data center on its OSL04 campus in Holtskogen (Oslo).

"We have already implemented power plants with engines operating on biofuels, as our recent contract with French utility EDF for a 130-MW power plant on the island of Corsica [France] underlines," Fiedler said, noting that MAN Energy Solutions is also seeing demand for engines that can operate on synthetic fuels derived from electrolysis, such as green hydrogen, e-methane, and ammonia. "Already today, our engines can be designed to operate on climate-neutral fuels like e-methane or be retrofitted at a later stage, based on availability of the fuels," he added. Furthermore, Fiedler said MAN Energy Solutions is collaborating with partners on two projects, called AmmoniaMot and HydroPoLEn, to develop advanced hydrogen and ammonia solutions. Both projects are supported by the German Federal Ministry for Economic Affairs and Climate Action.

*—**Aaron Larson** is POWER's executive editor.*

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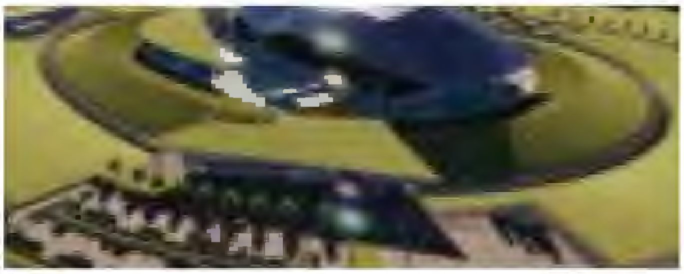

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by Aaron Larson

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