APRIL 2024

WHAT HAPPENS WHEN A NUCLEAR PLANT AND A DATA CENTER SHACK UP?

TONY CLARK
SENIOR ADVISOR, WILKINSON BARKER KNAUER LLP

VINCENT DUANE
PRINCIPAL, COPPER MONARCH LLC
(FORMER SVP LAW, COMPLIANCE & EXTERNAL RELATIONS WITH PJM INTERCONNECTION, LLC)

The runaway appetite of data centers for electricity, supercharged by the prospects for AI, is producing staggering forecasts for generation and transmission expansion. This comes alongside other new demand, such as the resurgence of onshore manufacturing and the electrification of heating and transport. At the same time, environmental policy is hastening the retirement of fossil-fueled power stations and the resources lining up to replace them are inadequate in capability, insufficient in number and stuck in lugubrious interconnection processes.

Considering the disquieting mathematics of expected supply to meet forecasted demand, policymakers need to take a hard look at data center interconnections. We cannot and should not use regulation to prevent the interconnection of data centers. But policymakers should examine how data centers are coming on-line. Most have connected in the traditional manner – as retail load, served off the distribution system. A more recent approach involves the colocation of data center campuses with dedicated generation "inside the fence."

Colocation models can involve the promise of developing new generation to supply an accompanying data center campus. This raises the interesting prospect of demand spurring innovation and investment in new purpose-built generation, such as small modular reactors or hydrogen fueled solutions, and for self-sufficient microgrids to support accelerating data center load. Exciting, no doubt, but still more theoretical than immediate reality.

What "colocation" means today - in the present time - is the development of data center campuses adjacent to existing plants, particularly existing nuclear power stations. The campus is designed to tap directly into the plant. This affords the data center a dedicated, time-matched source of zero-emission supply and service which, arguably, is more reliable than a grid-connected configuration.

So, what's not to like? Before examining that question, note that the model of colocated campuses at existing nuclear stations is happening in RTOs, and not at non-RTO facilities like Brown's Ferry, Vogtle or Turkey Point – even as Tennessee, Georgia and Florida themselves see notable data center load growth. Not a coincidence, we'd argue. Powerful economic incentives in RTO regions work to motivate data campuses to colocate with existing nuclear plants and skip the path of slow, messy and more expensive grid interconnection.

Policymakers and regulators in RTO regions must examine closely whether incentives inherent to organized markets are inviting a model of colocation that (i) results in unfair rate impacts to consumers, (ii) challenges reliable system operations, and (iii) promotes a "shell game" for marketing rights around zero-emission electricity.

THREE ECONOMIC INCENTIVES

The leading examples of data center/nuclear colocation involve plants participating in RTO markets and owned by non-utility merchants - operators not tied directly to retail customers and ones whose fortunes depend on RTO wholesale market prices. Until recently, these markets struggled to retain installed nuclear and insufficient market revenue resulted in several plants retiring. What a difference a couple of years makes. Palisades, which shuttered in Michigan just two years ago, is well on its way to an historic return. Talen emerged from bankruptcy just last year. And merchant operators Constellation and Vistra enjoy stock prices that are presently soaring. But it's not as if the RTOs important to these nuclear operators, like PJM, have fixed their markets to start paying these plants a living wage. For example, in 2023 average energy prices (LMP) in PJM decreased 61.2% from 2022. PJM's market monitor reports this was the largest annual price decrease ($49.06 per MWh) and the largest annual percentage price decrease since the creation of PJM markets in 1999.

So, while the RTO market is an important predicate to the recent success of these operators, something other than market performance (i.e, the price outcomes in these markets) is at work to explain their dramatic turnaround. This "something" can be understood by examining (i) federal and state clean energy subsidies and programs, (ii) their impact on both wholesale prices and retail prices in RTO regions, and (iii) how they combine to create powerful economic incentives which drive a merchant nuke to cohabitate with a data campus.

1. Volatile and Generally Suppressed Wholesale Market Prices

As mentioned, prices in RTO markets are broken. Average energy and capacity prices are artificially low due to the penetration (through subsidy and support) of zero-marginal cost resources. Allowing these price taking resources to participate in price formation suppresses clearing prices because their uneconomic entry effectively moves the supply curve to the left.

Merchant nukes live or die based on what the RTO's wholesale market pays them for energy, capacity and grid services. That is, unless they can find other, non-market sources of revenue. One such opportunity, a power purchase agreement (PPA), looks increasingly appealing to nuclear operators in RTO markets. Not only does a PPA offer the seller a higher average price than what the market would deliver, it offers a certain price - one not subject to the volatility of the RTO's wholesale electricity markets. Particularly for publicly traded operators, this certainty can be transparently communicated to investors whose valuation of the company's stock is otherwise discounted on account of uncertain price outcomes in RTO markets.

2. The Nuclear PTC Under the IRA and State Zero Emission Credits

Usually, however, the seller under a fixed-price PPA must worry that prices in the RTO's wholesale market might rise and its fixed-price PPA commitment becomes an out of the money liability. Not really a concern for operators in RTO markets as it turns out, because this risk is fully hedged by virtue of the nuclear PTC under the IRA and by retail ratepayers (in some jurisdictions) providing ZECs. But there's more! Not only is the downside risk to the nuclear plant now covered, the upside which can take the form of PPA revenues or RTO market revenues (realized by that portion of the plant which remains grid-connected) and which may exceed the returns necessary to maintain the financial health of the plant as a whole, can be retained usually without offsetting any of the value of the PTC or ZEC subsidy.

Okay, so low RTO wholesale market prices and the raft of recent legislative support enabling nuclear plant owners to lock in a floor price that creates the condition for nuclear PPAs. These two incentives explain why contracting outside the RTO's markets may be attractive to sellers of nuclear energy. These arrangements, however, can be done financially without actually pulling nuclear MWs and MWhs off the grid. In RTOs, where a nuclear plant and data center physically shack up, we're seeing a third incentive at work – this one motivating the behavior of the buyer.

3. Avoiding Costs - Some that were once Manifest in RTO Wholesale Markets but now Appear in Downstream Retail Markets

A customer that colocates avoids "wires charges" – the fixed costs of the poles, wires, transformers and substations that comprise the transmission and distribution network. These costs are increasing and the call for massive investment in grid infrastructure to support the energy transition, harden the grid from extreme weather, physical and cyber vulnerabilities and replace aged infrastructure, only promises further escalation.

Less obvious are other non-bypassable charges that show up in the retail bill. These charges support state programs whose costs in the past were relatively modest – such as low-income assistance or energy efficiency weatherization – but now represent a significant percentage of the cost of delivered energy because they serve to fund RECs, and ZECs and other subsidy programs for clean energy and advanced technologies. These charges are tied to the bill from the local distribution utility. So, avoiding this utility by colocating allows the customer to bypass supposedly non-bypassable charges.

Even less obvious is that, because the widely accepted "missing money" problem in RTO energy market is worsening (on account of the price suppression discussed above), costs that should be manifest in wholesale energy market prices, are being reconstituted (to some degree) by RTOs as transmission or capacity market costs or other operating charges that for various reasons are not captured in LMP. These charges collectively are significant and go by various names such as uplift, conservative operations, operating reserves, start-up, no-load and reliability must run costs.

And guess what? All these costs, along with a share of administrative costs to fund the RTO, NERC, FERC, etc., are also allocated by the RTO to the local distribution utility, and passed through in retail rates, alongside wires charges and other non-bypassable charges.

For states that have adopted full utility restructuring and retail open access, this presents an acute problem. When policies work to suppress wholesale electricity prices and correspondingly inflate retail costs for delivered electricity, there's simply not much left for retail suppliers to compete over or to motivate retail customers into switching suppliers. But what will excite a customer is a power supply arrangement that allows it to avoid altogether the retail utility and, in so doing, bypass this burgeoning bucket of supposedly non-bypassable charges.

So, it takes a unique confluence of incentives and unintended consequences to create conditions supporting inside-the-nuclear-fence load. Nuclear units that operate outside of RTOs and those that remain part of a regulatory framework where the investment is dedicated to franchised customers who in turn pay cost of service rates are unlikely candidates for colocation strategies. And beyond data centers, it takes imagination to envision other energy-intensive operations (such as electric arc furnaces or smelters) finding a way to colocate with existing nuclear facilities. So, while this phenomenon might have a limited runway, it would be a mistake for policymakers, regulators, and retail customers in RTO regions to dismiss it as no big deal. We see three areas that call for inquiry.

QUESTIONS ARISING FROM COLOCATION

1. Economics and Fairness

Once energy and capacity is dedicated to serve inside the fence load it's removed from the RTO's wholesale energy and capacity markets.[1] Losing these resources from the supply stack increases clearing prices for grid-connected customers. These supply and demand economics don't change when the data campus is connected to and served by the grid. But the traditional approach to load interconnection comes with greater transparency and established regulatory processes that permit policymakers, customers and other stakeholders to understand and debate the impact of these interconnections.

For example, in Virginia, the proposal to meet grid-connected data center growth through both new natural gas generation (such as Dominion's 1000MW Chesterfield County project) and new large transmission projects in the mid-Atlantic is spawning debate at PJM, in Richmond and at FERC. Here consumers, environmentalists and neighboring states are raising questions of burden and debate the allocation of these burdens, including costs that will fall outside of Virginia and on consumers in other PJM states.

The debate and processes that characterize traditional grid interconnection stand in marked contrast to the essentially unregulated connection of colocated load. This opacity impedes policymakers from weighing the public interest in say, the equity in having a specific data campus industrial rate schedule, or the pros and cons of tax or economic development incentives to attract data center investment, or possibly regulating energy efficiency standards or requirements for back-up generation required from data center customers.

But the real cost shift occasioned by colocation goes back to the wires and so-called "non-bypassable" charges discussed earlier. Let's illustrate using simple but representative rate estimates. Assume a typical rate on file for a utility to serve a grid-connected data center at retail in the mid-Atlantic is $0.08 per kWh. Average energy prices (LMP) in PJM in 2023 according to the IMM's State of the Market Report came in around $0.03 per kWh.

[1] In PJM, situations where the nuclear plant can assure that its inside the fence customer will be immediately curtailed if the plant goes off-line raises a question whether the inside the fence load is "consuming" capacity from the plant. This engenders debate over the metaphysical definition of capacity. PJM's position is that the plant cannot sell its full MW capacity value into PJM's auctions and must account for the portion that has already been "sold" bilaterally to the colocated load. Some operators disagree and would prefer to continue fully participating in PJM's capacity market as they have done historically, essentially asking the RTO to close its eyes to the huge data campus that has sprung up inside its fence.

Even accounting for historic LMP variability and the wholesale seller's lost revenue opportunities (as could be realized in the RTO's capacity and ancillary service markets) the chasm separating 8 cents from 3 cents shows how both nuclear seller and data campus buyer are driven to form a PPA priced somewhere in the middle.

Some significant portion of this 5-cent differential represents wires costs and other non-bypassable charges that are fixed and must therefore be shifted to grid-connected customers. This cost shift should be accepted, so the argument goes, because colocating means the data campus doesn't use the grid and thus, shouldn't have to pay for it.

Going off-grid does not justify avoiding most non-bypassable charges. Because retail electric rates serve as a convenient funding and collection mechanisms for programs that have no relationship to distribution and transmission itself, the non-bypassable charges resulting from these programs are distinct from actual "wires charges" and equity demands they be borne by all electricity consumers. But the case is also strong to charge actual "wires charges" to colocation customers. It's hardly the case that colocation occurs without impact to the grid – impact that causes expensive infrastructure additions. We'll turn to these impacts below – but for the moment, consider PJM's recently approved $5 billion grid expansion plan, much of it driven by data centers in Northern Virginia coming on-line in the traditional grid-connected configuration. Does anyone believe the transmission needs identified by PJM would go away or cost materially less if each of these data centers had found a way to colocate?

Colocation, simply stated, subsidizes the data campuses involved. The arrangement will create needs for new transmission and generation and other customers, including those competitor data centers interconnecting the old-fashioned way, will be stuck paying the full tab left behind by the cohabitating couple.

2. Reliability

The interstate transmission grid was planned and developed over the past century to support the delivery of fossil and nuclear plants to load centers. The retirement of fossil plants, and their replacement with renewable generation that performs differently and requires different support from the transmission network, present reliability challenges that NERC and system operators are voicing with increasing volume and alarm.

On the heels of fossil retirement, now comes data center colocation with existing nuclear. Of course, colocation doesn't result in the retiring of the nuclear plant. But from the perspective of the system operator, charged with maintaining operational security and resource adequacy, the effect isn't much different. When a nuke dedicates output to inside the fence load, it deprives the system operator of a resource it otherwise would rely on to serve grid customers, provide grid services to support delivery of electricity and serve as capacity to meet resource adequacy requirements.

It's not apparent sufficient efforts, such as rigorous load flow modeling, have been undertaken to study what happens to a transmission network when resources it was designed to deliver are physically disconnected from the network. But common sense says it will spur yet more demand for new transmission infrastructure to replace the inertia/frequency response, stability and voltage support the nuke previously provided.

And, of course, there's no escaping the need for simply more generation to replace what's lost due to the colocation arrangement. New demand, both grid-connected or inside the fence, will pressure existing infrastructure and create the need for new supply. But the trending towards colocation tells us that it's quicker and easier to build a data campus with inside the fence interconnection facilities to existing generation, than it is to build the new generation and transmission needed to support the data center if it were to interconnect in the more traditional manner. This raises obvious cost allocation and fairness questions.

3. The Zero-Emission Shell Game

Finally, colocation feeds the myth of the "sustainable" data center. Connecting a 500 MW data campus to siphon 500 MWs from an existing nuke isn't reducing system emissions or advancing decarbonization goals. It merely kicks the carbon can down the road.

Colocation may make data center owners and their users feel good about their individual carbon footprints. But their action has just made the carbon picture of the rest of the system worse, and the total system no better. And unless the capacity lost to the system from colocation is replaced with new nuclear or the almost unimaginable equivalent of wind/solar/storage and transmission (or some breakthrough new zero emission technology), then when all is said and done, interconnection of the data campus has increased carbon emissions.

WHAT SHOULD POLICYMAKERS DO?

Ideally, we would fix price formation in RTO markets to remove the incentives driving merchant nuclear owners toward colocation. This is a herculean task, complicated by steps already taken by policymakers at both state and federal levels providing powerful financial support and subsidy for zero-emission generation, distorting RTO markets and suppressing RTO revenues to all sellers.

Looking downstream from the RTO, colocation still involves a retail sale. State regulators therefore have some ability to regulate the terms and conditions of this sale. This creates the possibility to reimpose on the data center many of the non-bypassable charges that have been bypassed. State lawmakers would need to examine their individual regulatory regimes to determine how extensive such regulation could be and whether it would be sufficiently effective to avoid cross-subsidization or undue cost shifts between customers.

One action that would effectively deter colocation would be to eliminate the federal PTC and accelerate the expiry of state ZECs for any portion of nuclear capacity dedicated to inside the fence load. Through these support mechanisms, the public has already purchased the environmental attributes of the plant. It can be argued that once this plant is severed from the grid, and thus no longer "in the public service" so to speak, the burden of paying for zero-emissions should shift from the public to the inside the fence customer. Preserving these incentives for grid-connected nuclear generation and future colocation arrangements that couple new zero-emission resources with dedicated load would encourage an equitable and truly carbon progressive form of colocation.

CONCLUSION

Let's be clear, we can't afford to lose any nuclear plants due to suppressed RTO wholesale market prices. Neither are we casting stones. The firms entertaining these arrangements are making rational economic decisions based on the incentives imbedded in the regulatory and policy structures in which they operate. But asking tax and ratepayers to support these plants only to see them excuse themselves from the supply stack and, in so doing, leave a complicated mess of cost and reliability burdens at the feet of these same tax and ratepayers seems facially unfair. And that's before even considering the distortions arising from the convergence of different policies that unintentionally result in subsidies to data campuses and financial windfalls for merchant nukes.

The early naivete that led many to think costs to transition to a decarbonized grid would be modest, is giving way to a more sober appraisal informed by real world experience. With this context in mind, policymakers should scrutinize how data campus load is coming on-line. If affordability, reliability and fairness across customer classes are still duties of regulators and lawmakers – and they are – then the nuclear/data campus colocation arrangements presently underway in RTO regions should be sparking heated debate as to what's in the public interest.