TPMC/PORTS-136

Theta Pro2Serve Management Company, LLC

Environmental Management & Enrichment Facilities

Evaluation and Analysis of a High Voltage Supply Option for the X-530 Switchyard from the X-533 Switchyard at the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio

Managed by
Theta Pro2Serve Management Company, LLC
for the Portsmouth/Paducah Project Office
of the United States Department of Energy

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Henry Thomas 3/8/2007

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Evaluation and Analysis of the High Voltage Supply Option for the X-530 Switchyard from the X-533 Switchyard at the Portsmouth Gaseous Diffusion Plant Piketon, Ohio

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THETA PRO2SERVE MANAGEMENT COMPANY, LLC
managing the
Infrastructure Activities at the
Portsmouth Gaseous Diffusion Plant
under contract DE-AC24-05OH20193
for the
U.S. DEPARTMENT OF ENERGY

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ACRONYMS

ACP	American Centrifuge Plant
AEP	American Electric Power
D&D	decontamination and decommissioning
DOE	U.S. Department of Energy
GCB	gas-insulated circuit breaker
GCEP	Gas Centrifuge Enrichment Plant
OCB	oil-insulated circuit breaker
O&M	operation and maintenance
OVEC	Ohio Valley Electric Corporation
PORTS	Portsmouth Gaseous Diffusion Plant
ROM	rough order of magnitude
UDS	Uranium Disposition Services, LLC

EXECUTIVE SUMMARY

Analysis options for minimizing the long range operation and maintenance (O&M) cost of the Portsmouth Gaseous Diffusion Plant (PORTS) switchyards and posturing the plant for decontamination and decommissioning (D&D) have previously recommended a 13.8kV bypass of the X-533 Switchyard using a new distribution system that emanates from the X-530 Switchyard[1]. Since then, significant additional M&O costs associated with "good utility practice" maintenance standards and enhanced reliability initiatives driven by the EPAct2005 required to keep the DOE switchyards on the grid, has posed a new alternative to be evaluated. This alternative would power the X-530 Switchyard at 345kV from the X-533 Switchyard so that the X-530 Switchyard becomes a radial load fed from the X-533 Switchyard and not a grid node. This would alleviate the additional costs of the X-530 Switchyard upgrades but would retain both switchyards in service. **This approach is shown to have a total estimated cost of approximately $27M with minimal reduction in ongoing O&M costs, significant reductions in load serving reliability, and continuation of an obstacle to D&D and deferred unit resolution. This approach is generally not recommended unless some unknown at this time synergies or management imperatives with Ohio Valley Electric Corporation (OVEC) or American Centrifuge Plant (ACP) show value that likely exceeds the cost.**

[1] R.W Craycraft, TPMC/PORTS-8, September 2005

1. INTRODUCTION

The purpose of this evaluation is to explore the cost and benefit of powering the X-530 Switchyard from the X-533 Switchyard in order to make the X-530 Switchyard a radial feed from the X-533 Switchyard and thus not subject to grid driven reliability issues. A secondary objective would be to establish the X-533 Switchyard as the future grid interconnectivity node for the U.S. Department of Energy (DOE), Ohio Valley Electric Corporation (OVEC), and American Electric Power (AEP). This would also seemingly enable a X-533 Switchyard privatization initiative expected to be preferred by OVEC due to the superior material condition of the X-533. The basic approach would be to provide a new twin (minimum acceptable for reliability) 345kV feed to the X-530 Switchyard from the X-533 Switchyard while disconnecting all OVEC and AEP interconnections from the X-530. This evaluation will provide a rough order of magnitude (ROM) cost for DOE to establish this configuration at the Portsmouth Gaseous Diffusion Plant (PORTS). Powering the X-530 loads from X-533 at 13.8kV is not considered viable due to the large number of replacement feeders needed for all residual DOE load, Uranium Disposition Services, LLC (UDS), and the need to still step up to 345kV to power the American Centrifuge Plant (ACP).

1.1 GENERAL APPROACH

The following approaches have been established for this bounding exercise:

- For grid interconnectivity and load servicing reliability, the X-533 Switchyard will at a minimum retain the same incoming transmission line capacity and configuration as now exists. This will include two Pierce lines (from the west) and two Kyger lines (from the east) with a tie to the AEP Don Marquis 765/345kV Switchyard.

- A minimum of two 345kV feeds must be provided to the X-530 Switchyard to assure redundancy based reliability for residual DOE and UDS loads as well as the ACP. The X-530 Switchyard will thus become a load from the X-533 Switchyard. All other transmission feeds to the X-530 will be disconnected. The transmission feed to be disconnected are: the 345kV tie to the Don Marquis Switchyard, the two 138kV lines to the AEP Pike and Millbrook Switchyards, the two Pierce 345kV transmission lines, and the two Kyger 345kV transmission lines. The disconnected transmission lines will likely need to be reconnected at a site (switchyard or other superstructure) away from the DOE switchyard with the cost of this expected to be born by OVEC, are therefore not included in this estimate.

2. SYSTEMS

2.1 SYSTEM DESCRIPTION

Currently, the X-533 Switchyard consists of six 345kV bays containing three high voltage gas [sulfur hexafluoride (SF_6)]-insulated circuit breakers (GCBs) positioned between two 345kV, three phase busses (Fig. 1). This is referred to as a breaker-and-a-half design, wherein, an incoming line drops between the outer most breaker, and the middle breaker. The load feed (commonly a transformer pair) exits between the inner most breaker and the middle breaker. Since the middle breaker is "shared," the two lines (feed and load) each have one-and-a-half breakers. The drops from the load/line feeds is effected by tapping

overhead lines strung between three steel structures which rise above the 345kV Busses. These taps drop between the appropriate bay breakers. The one unique feature of the X-533 Switchyard is that while there are six bays, only five feeds come into the switchyard. The sixth bay consists of two load feeders instead of the normal feed/load combination.

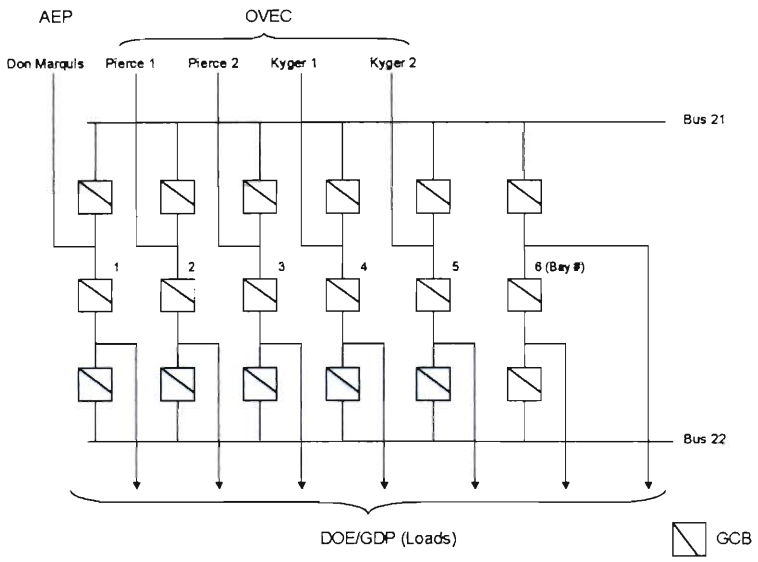

Fig. 1. X-533 existing arrangement.

The X-530 Switchyard consists of six 345kV bays containing three high voltage oil-insulated circuit breakers (OCBs), one 345kV bay containing three high voltage SF_6 GCBs, and one bay containing two high voltage SF_6 GCBs. All bays are positioned between two 345kV, three phase busses (Fig. 2). Transmission line and transformer feeds are arranged similar to the X-533 Switchyard with the exception that taps for three underground 345kV oil-filled cables occupy three positions in order to provide a redundant and diverse supply to the Gas Centrifuge Enrichment Plant (GCEP)/ACP X-5001 Switchyard.

2.2 NEEDED SYSTEM CHANGES

In order to maintain the current five X-533 Switchyard feeds (Pierce 1 & 2, Kyger 1 & 2, and the Don Marquis feed) and provide two new feeds to the X-530 Switchyard, the following configuration changes are proposed:

- Utilize the twin load transformer bay to establish the X-533 Switchyard end points for the two X-530 Switchyard feeds. This approach is viable since the transformers in this bay of the X-533 Switchyard are not needed for the current post shutdown 13.8kV feed configuration. The steel super structure for dead-ending one incoming feed currently exists. The second will have to be constructed or established by re-configuring it from its current route as a transformer feeder. If this is done as a re-configuration, the breakers can remain located and configured as they are, although the relay scheme will need to changed from the current load-feed operation to a line-feed. If a new super structure is built, it will also require an extension of the two 345kV busses, relocating two of the existing GCBs, and routing new control cables from the breakers to the Switchyard Control Room.

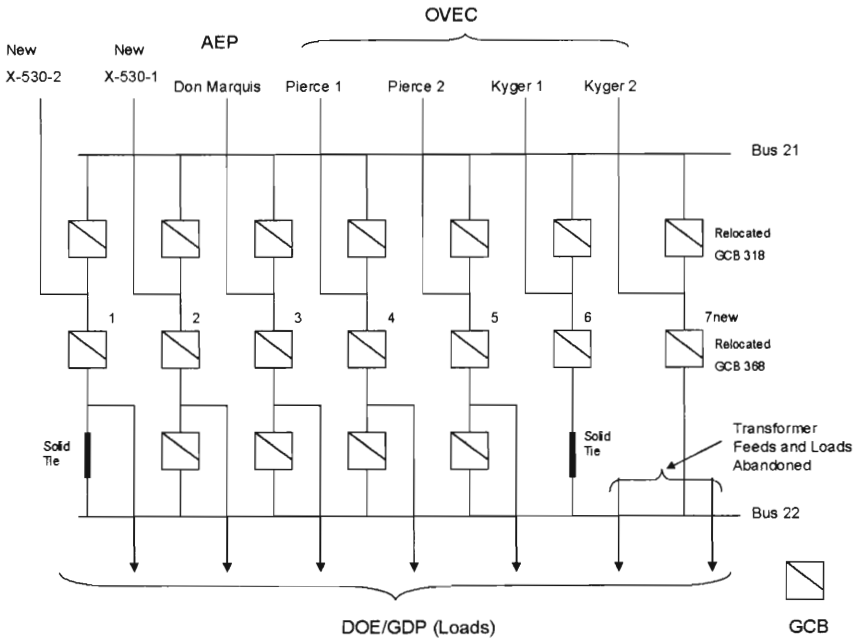

Fig. 2. X-533 modified arrangement.

- All of the existing incoming lines will need to be "relocated" from where they currently dead end on the X-533 Switchyard steel superstructure. The relocation will consist of shifting the dead end points, two bays East of where they currently reside. This will result in the opening of two bays on the west end of the switchyard. By exiting this end of the switchyard, none of the current incoming lines will need to be traversed by the two new 345kV, X-533/X-530 connecting feeders. This is significant, since maintaining clearances between intersecting 345kV lines requires huge tower structures at the crossing point. Figure 3 (Single Line Diagram of the modified X-533 Switchyard) shows the proposed configuration changes.

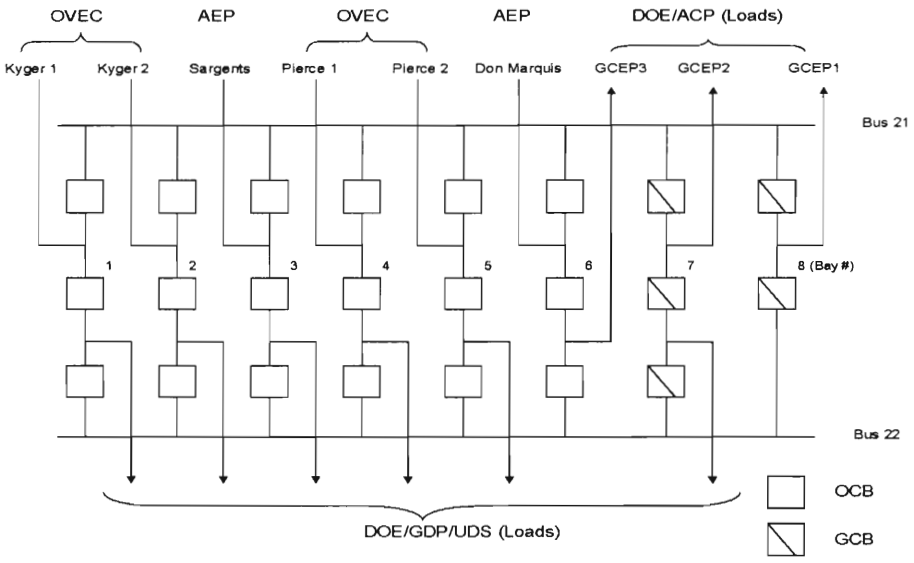

Fig. 3. X-530 existing arrangement.

- The two new X-533 to X-530 345kV lines will be routed via twin circuit towers. Depending on the tower site location and span design utilized, this connection can be achieved using four or five new towers. It may be possible to utilize the foundation base of one of the single circuit towers currently connecting the X-530 Switchyard and the Don Marquis Switchyards. Figure 4 depicts the proposed circuit route for the two X-530 to X-533 connecting feeders.

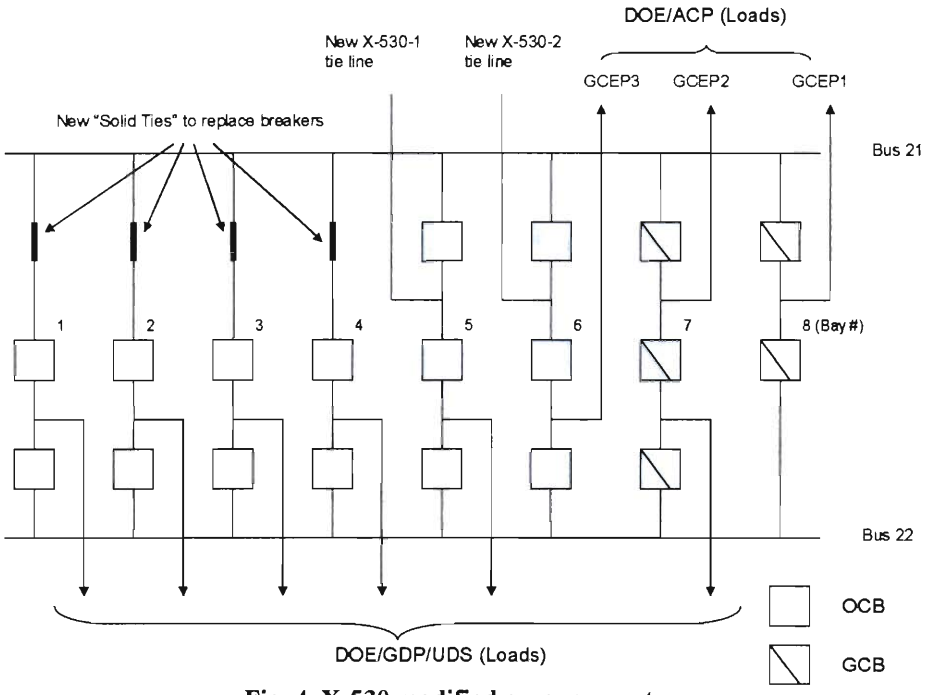

Fig. 4. X-530 modified arrangement.

- Since all of the existing incoming OVEC and AEP lines at the X-530 Switchyard, are to be removed, ample opportunity will exist to establish an optimum dead end point for the two new 345kV feeders. Figure 5 (Single Line Diagram of the X-530 Switchyard) shows the proposed configuration changes to this switchyard.

2.3 COST OF CHANGES

The total expense of performing the above listed configuration changes is estimated to range between $25M and $30M. A preliminary breakdown of costs is shown in Table 1.

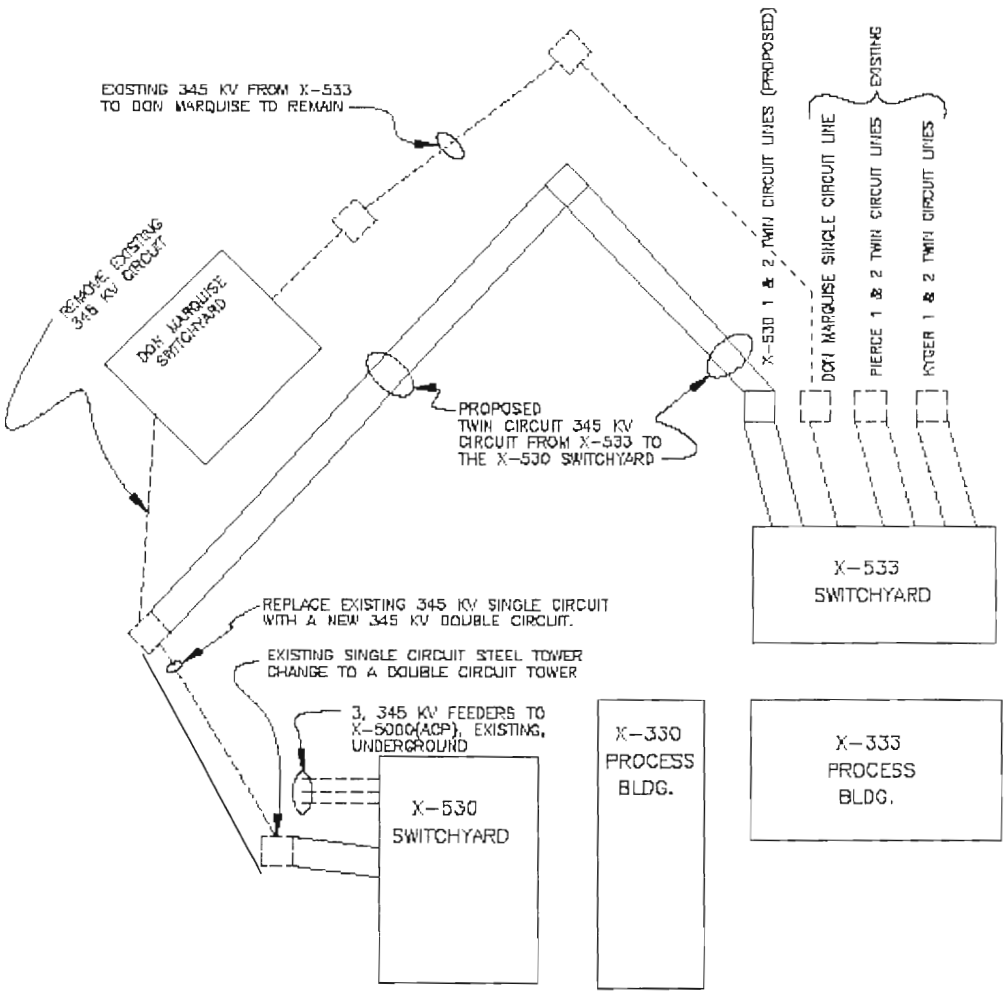

Fig. 5. New circuit routing.

Table 1. Preliminary breakdown of costs relating to configuration change

Cost Item	Number needed	Total ROM cost ($K)
Public Utilities Commission of Ohio, National Environmental Policy Act, Environmental Impact Statement, and regulator approval	1	250
Double circuit steel transmission towers	4	3000
1 ½ mile new conductors along with associated insulator/conductor attachments for the new lines	1 lot	1500
Right-of-way clearing and construction of temporary roads for installing new twin circuit line	1 lot	200

Table 1. Preliminary breakdown of costs relating to configuration change (continued)

Cost Item	Number needed	Total ROM cost ($K)
Reconfiguring four bays of the X-530 Switchyard to a two-breaker bay arrangement (i.e., remove the "two" breaker from each of these bays)	4	1200
Relaying modifications in the X-530 Switchyard	1 lot	500
Additional relays and associated control panels in the X-533 Switchyard to accommodate the two new 345kV feeders to the X-530 Switchyard	1 lot	2000
Metering and Supervisory Control and Data Acquisition modifications for the two new bays in the X-533 Switchyard	1 lot	1000
Extending the two existing 345kV busses in the X-533 Switchyard	2	2000
Relocating two of the GCB Breakers in the X-533 Switchyard	2	1000
Relaying modifications in the X-533 Switchyard to accommodate relocation of two breakers	1	500
Adding an additional bay to the X-533 Switchyard steel superstructure	1	1500
Adding an additional coupling-capacitive potential transformer and tying it into the existing potential transformer circuitry in the X-533 Switchyard	1	500
Jumpering abandoned breaker positions (both yards)	1 lot	500
Revisions of Incremental Power Demand Computer program and pulse generator locations	1 lot	200
Total Labor and Material		**15,850**
Engineering (15%)		**2378**
Project Management (25%)		**4557**
Management Reserve/Contingency (25%)		**4557**
Grand Total		**27,342**

3. APPROACH

3.1 BENEFITS OF THIS APPROACH

For DOE, the most significant objective achieved by feeding the X-530 Switchyard exclusively from the X-533 Switchyard, would be establishing the X-530 Switchyard as a radial fed entity, thereby, potentially exempting it from the compliance with regulatory enhancements required by EPAct2005. It would make the up-to-date X-533 Switchyard the regional grid inter-tie switchyard that might be more easily made compliant with good utility practice maintenance standards as well as EPAct2005. The X-533 Switchyard also is conveniently located close to Perimeter Road and thus could more easily be fenced out of the security limited area in the event of a desired turn over to a private entity (operating and

maintaining switchyards are an inherently non-governmental function that lends themselves to privatization per DOE policy).

3.2 DISADVANTAGES OF THIS APPROACH

The most significant detriment to this configuration in addition to its up front cost is the loss of reliability. While this is less important than in the past to the current and known future DOE needs, it could be severe to the ACP, since it places the entire load service on the new two circuit DOE transmission line with no geographical or source diversity. Additionally, what is currently a 7-circuit served load becomes a 2-circuit served load. During times of breaker maintenance, one of the two feeders powering the X-530 Switchyard and thus ACP would have to be taken out of service. This would place the entire switchyard in a single-failure mode for the duration of the maintenance evolution. Additionally, since both X-530 feed conductors will be in part on the same tower structures, a single natural phenomenon (tornado) or terrorist act would disable most of the PORTS site including UDS, ACP, and DOE-Environmental Management. Approaches to provide supply and geography diversity were considered but dismissed as unreasonable due to the requirement to circumnavigate the site with a new tower line at enormous cost. In the event that ACP obtains an independent power supply capability, these concerns will cease to be an issue. In any event, the X-530 Switchyard will still need to be maintained at or about the same level as is the current practice to assure continued reliability of service to site loads. Both switchyards will still need to be staffed by qualified operators at about the same level as is currently experienced.

An additional and potentially significant detriment to this approach would be the fact that D&D of both switchyard would be indefinitely delayed for as long as there is a site presence requiring significant power loads. This would also require extending the "deferred unit" status of the X-533. If the current exceedances of polychlorinated biphenyls in the North Holding Pond are determined to be from the X-533, the consequence of this delay in regard to the U.S. Environmental Protection Agency (USEPA)/DOE consent decree is unknown.