SYSTEM IMPACT STUDY REPORT
(MISO G867)

GENERATION INTERCONNECTION IN

MONROE COUNTY, MI

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ATTACHED APPENDICES

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Disclaimer

The analysis contained in this report was performed with assumed data based on preliminary results from higher queue projects, conversations with the customer, and on data provided by the manufacturer for the actual units. This assumed data includes information for these study units, other units that may become operational, and any transmission upgrades associated with these interconnection requests. Actual machine and other equipment parameters do vary and can have an impact on performance not witnessed in the study results. Future situations that differ from the assumptions contained in this report may affect the interconnection and/or operation of the facility. ITC*Transmission* makes no guarantee that these or other factors not foreseen during the study will not impact the proposed generating site.

Furthermore, the models used for this study were based on expected topology and system conditions (load, generation dispatch, reactive devices, ect.) for the 2017 time frame. The assumptions made in the models came from the best information available as of the date of this report, and are speculative in nature. The proposed network upgrades required to connect the generator that are detailed in this report should be revisited as the in-service date of the plant gets closer and the topology and system conditions can better be predicted. Ultimately, a different set of upgrades may be required.

INTRODUCTION AND PURPOSE

This report contains information on the study of the proposed interconnection of a 1563 MW Nuclear Turbine with the ITC*Transmission* transmission system in Monroe county of Michigan. This study was performed by ITC*Transmission* with contributions from Detroit Edison, Consumer's Energy, First Energy, AEP, and Wolverine.

The ITC*Transmission* system transfers power from power plants to local distribution systems. The ITC*Transmission* system also carries power resulting from transfers from power plants to loads across the Eastern Interconnection.

The purpose of this Interconnection Study is to give an indication of constraints on ITC*Transmission*'s system, Detroit Edison's system, and other neighboring systems arising from the proposed interconnection of the aggregate of the Nuclear Plant generation. These types of constraints include thermal equipment overloads, voltage criteria violations, breakers that exceed their rated capabilities and constraints related to maintaining system stability. In addition, this System Impact Study will provide a preliminary, good faith estimate of the nature, extent, and cost of the facilities that may be required to inject the output of the generator facilities to the grid. The constraints contained in this report were identified by analyzing various load flow, short circuit, and stability results.

1. CONCLUSIONS

The power flow studies show that the full output of the proposed Enrico Fermi Nuclear Turbine #3 does contribute to post contingency overloads on ITC*Transmission* facilities. The overloads were evident on the 345 kV, 230 kV and 120 kV systems near the points of interconnection. Transmission system enhancements will be necessary, and some sub-transmission upgrades may be required, in order to facilitate the interconnection of the proposed generation to the ITC*Transmission* system.

The addition of the proposed generator did increase the available fault current enough to put the existing 345 kV breakers at the Fermi switchyard near their interrupting capabilities. Therefore the new Fermi 3 switchyard will have to be electrically separate from the existing Fermi 2 switchyard, or else all the breakers at the Fermi #2 switchyard will have to be replaced and stability issues will arise.

Based on the assumptions contained within this report including the ability of the Nuclear plant to maintain its stated power factor capabilities, it is not expected that the proposed plant would cause any steady state voltage violations. However, if any or all of the assumptions made in this study with regard to the Generator and Interconnection Facilities change, there will be a further review necessary to determine the additional reactive requirements for the proposed interconnections.

Stability results have shown several fault scenarios at both Milan Station and the new Fermi #3 switchyard caused the Fermi #3 unit to become unstable. Therefore it was necessary to keep the

Fermi 3 and Fermi 2 switchyards separated, construct a 3rd line to Milan, and to configure both Milan and the Fermi 3 switchyard as shown on the one line in appendix A.

There are several network upgrades that will be required to facilitate the interconnection of the Nuclear Plant. These would include building a new 345 kV station at Fermi, expanding the existing 345 kV station at Milan, cutting the existing 345 kV Lemoyne-Majestic circuit into Milan, and Constructing 3 new 345 kV circuits from the new Fermi station to Milan station. A one line of these upgrades can be found in appendix B, and the preliminary cost estimate for these upgrades is $97.1 Million.

MISO subsequently completed the required Deliverability Analysis for this project to be granted Network Resource Interconnection Service. Their analysis did not find any additional constraints requiring mitigation with the previously identified network upgrades modeled. Thus, the project is deemed to be fully deliverable (1563 MW) contingent upon the Network Upgrades identified in this study report.

Neighboring utility First Energy Corp. performed a short circuit review at selected substations on their transmission system to capture the effect on breaker interrupting duties as a result of the new Fermi #3 unit and the proposed network upgrades. No breakers were found to be overdutied on the FE system.

The neighboring regional transmission organization, PJM Interconnection, was also given an opportunity to review ITC*Transmission*'s study and subsequently confirmed that this project did not impact any of their facilities and no additional analysis would be required on their system.

2. Study Summary

2.1 Study Methodologies

Thermal Loading and Voltage Studies

The ITC*Transmission* system was analyzed for thermal and voltage limitations for normal and post contingency conditions via power flow analysis using PTI's PSS/E and MUST power flow and contingency analysis simulation tools.

A table containing information on the Nuclear Plant proposing to connect to the ITC*Transmission* system can be found in Appendix A. A description of the models used for this analysis can be found in Appendix C.

The base case for this analysis was developed using the 2006 series RFC model for 2016 system conditions with ITC*Transmission*'s 2017 internal model inserted and scaled to match the current 2017 load forecast. The base case represents the expected system configuration and loading in 2017 including those ITC*Transmission* projects which are planned, meaning they have budgetary approval. The DTE subtransmission system used by ITC*Transmission* represents the system as given to ITC*Transmission* for the summer 2007 case building process and does not include any planned upgrades on the DTE system beyond that time. Because there are about 1107 MW of firm transmission reservations on the ties between ITC*Transmission* and Canada, the 4 phase shifting transformers between ITC*Transmission* and Canada were modeled as controlling flow in and out of ITC*Transmission* to about 1107 MW. This flow was distributed 1/6, 1/3, 1/3, and 1/6 across the B3N, L51D, L4D, and J5D interconnections respectively in the base case.

In order to determine the total amount of generation from the Nuclear Plant in aggregate that could be accommodated via the existing system, a transfer from the Nuclear plant in aggregate to all units within the MISO service territory (excluding ITCTransmission) was performed. Phase shifting transformers were held to constant flow during the transfer and at a fixed angle for contingencies and 0.5% Power Transfer Distribution Factor (PTDF) and Outage Transfer Distribution Factor (OTDF) cut offs were used.

There are several generators feeding the 345 kV in the area that the Nuclear Plant is requesting to interconnect. For the base case, the units were modeled as controlling voltage as follows:
Fermi 2 – Controlling the Fermi2 345 kV bus to 1.042 pu (359.5 kV)
Monroe 1 and 2 – Controlling the Monroe12 345 kV bus to 1.0333 pu (356.5 kV)
Monroe 3 and 4 – Controlling the Monroe34 345 kV bus to 1.0333 pu (356.5 kV)
This is consistent with the Generator Bus Voltage Schedule for peak conditions as required by NERC VAR-001-1 effective February 2, 2007. The voltage schedule for all units is subject to change.

The Nuclear Plant was modeled with MVAR capabilities based on the capability curves for these turbines provided by the interconnection customer. The G867 Nuclear Plant was modeled as attempting to hold a voltage of 1.041 pu (395.3 kV) at the point of interconnection. The study did not show any additional reactive requirements to meet ITC *Transmission*'s voltage criteria, or expected voltage schedule for this project. This finding is based on the turbine and transformer information provided by the developers. The results are subject to review and may vary if any significant changes to these assumptions occur.

Voltage analysis for the ITC*Transmission* system was performed utilizing transformer tap adjustments, applying generator VAR limits immediately, allowing switched shunts to regulate, locking phase shifting transformers, and disabling area interchange post contingency. Some switched shunts in the area were turned on pre-contingency in cases with a generator out prior to the contingency.

Cost Sharing

The total ITC*Transmission* cost estimate for the proposed upgrades was broken down into individual overhead sections and substation work. The Network Upgrades on ITC's system identified for G867 are subject to the credit according to the Article 11 of LGIA and Attachment FF of the MISO tariff.

Short Circuit Studies

ITC*Transmission*'s internal short circuit model was utilized to determine any breaker duty issues caused by the interconnection of the proposed Nuclear Plant. ITC*Transmission* utilizes Aspen Inc.'s OneLiner and Breaker Rating Module software tools to perform short circuit analysis. A subtransient reactance of 0.00923 per unit (on a 100 MVA base) was assumed for the proposed Nuclear Plant. If a more accurate subtransient reactance is determined a re-evaluation of the short circuit study will be necessary in order to verify the results contained within this report.

Breaker duties were determined for ITC*Transmission*'s planned system and then compared to those after the Nuclear Plant's interconnection and system upgrades required to support the aggregate of the proposed Nuclear Plant.

Stability Studies

ITC*Transmission's* transmission system stability standards are considered over a wide range of normal and contingency operating conditions. The procedure used, analyzes a range of test conditions, provides reasonable means of stressing the system to determine its stability limits, and consistently measures the dynamic impact of any new or increased generation capacity.

In accordance with the ITC*Transmission* planning criteria, the system was tested covering a range of probable power plant operating conditions, from 0.93 leading power factor to 0.90 lagging power factor, for generator and system dynamic response. All five ITC*Transmissio*n transmission criteria disturbance types were analyzed to test for plant and system dynamic stability. These dynamic fault clearing simulation tests included:

1. Three phase bolted faults with normal clearing by primary breakers and relays.
2. Simultaneous L-G faults on separate phases of separate circuits of multi-circuit tower lines with normal clearing by primary breakers and relays.
3. Double L-G faults with delayed clearing by backup breakers as a result of failure of a breaker to operate for any reason.
4. Three phase bolted faults with normal clearing by primary breakers and relays with a prior system element out of service.
5. Single L-G faults on breakers with normal clearing.

In addition, the faults of sudden loss of single critical generation were also simulated in the stability study.

Stability analysis was performed on ITC*Transmission*/METC 2017 80% model with the proposed Enrico Fermi3 nuclear unit and projected network upgrades included. The dynamic models and data for Enrico Fermi3 unit were provided by the customer. The other necessary dynamic models were obtained from the 2006 series RFC dynamics database. The tests under this assessment are performed as is for design purposes, for testing of the ITC*Transmission* transmission system and establishing generating plant/unit stability assessment against the ITC*Transmission* transmission testing criteria. No assurance is made that any of these simulated stability tests exactly represent the actual operating world.

The dynamic tests are performed in an effort to identify any potential instability or reduced margin of stability with the interconnection of the specific Enrico Fermi nuclear plant under study and its effect on the transmission system and other existing generating units' transient performance. Limits to plant design and/or output capacity or changes in the system and/or generator design parameter restrictions may have to be imposed to provide stability margins to meet the stability testing criteria. Such limits may include restrictions on total site capacity to avoid unit and plant instabilities, area load/generation capacity limitations and other remedies to ultimately avoid uncontrolled cascading system outages for less probable, but more severe disturbances required of the ITC*Transmission*, RFC, and NERC planning standards.

This study focused on the design requirements for the interconnection of the proposed Enrico Fermi 3 nuclear unit with the ITC*Transmission* transmission system. The study did not directly address nor perform any engineering for any of the work that the Enrico Fermi 3 nuclear unit may have to undertake to design the combined generator, step-up transformer station and attendant facilities at the plant for operation across the capacity ranges. This study, therefore, does not address any issues regarding proper design, engineering, operation or protection of the proposed Enrico Fermi 3 nuclear unit. The scope of this study was strictly limited to determining the impact that the operation of the Enrico Fermi 3 nuclear unit, at its maximum output, would have on the overall system.

Stability simulations were carried out using the PTI PSS/E suite of system simulation programs. All main disturbance simulations were run out for 10 seconds total duration and analyzed for transient stability and to access specific potential dynamic concerns (post transient). All local ITC*Transmission* transmission connected generating plants and units were monitored via output channels in each stability disturbance case run.

Significant to the simulation of the various disturbances are inherent system switching events that occur during and after fault and disturbance application. These events are modeled in a transient period and represent breaker-switching events controlled by system relaying for each system element involved in the disturbance. The switching events simulated include normal and back-up relay controlled breaker switching as well as breaker failure relay operation events. Since the disturbance simulation period covers up to 10 seconds after the initial disturbance application, no steady state control events are simulated that would only operate after a more lengthy time delay. Breaker-switching events are represented/simulated as they would actually occur in the system in real time, and as the control systems are designed. In general, these are represented by switching events at times based on total breaker clearing time and vary by system voltage level and type of relay system in use.

The 345 kV higher voltage system in ITC*Transmission* transmission system exclusively uses a pilot type relaying scheme and the clearing times simulated were 4 cycles for local and remote normal clearing, and 12 cycles for local and remote delayed clearing. The 120 kV and 230 kV systems also use a pilot type relaying scheme and the clearing times simulated were 6 cycles for local and remote normal clearing, and 16 cycles for local and remote delayed clearing. On the ITC*Transmission* transmission system, switching events were simulated as they actually occur including the inadvertent splitting of buses, line connections through middle breakers at ring busses and breaker and a half substations, inadvertent tripping of adjacent lines for breaker failure events and full bus clearing for bus faults.

2.2 INTERCONNECTION OF GENERATOR(S)

G867 is currently proposing to connect to the 345 kV at the Enrico Fermi Station in Monroe County, MI. See Appendix B one-line of interconnection facilities.

2.3 EXISTING GENERATION IN INTERNATIONAL TRANSMISSION COMPANY

In performing the studies for this report, existing power plants in the ITC*Transmission* area are connected as follows:

At 120 kV

- Conners Creek Units #15 & 16
- Harbor Beach Unit #1
- River Rouge Units #1, 2 & 3
- St. Clair Units #1 through #4
- Trenton Channel Units #7, 8, & 9
- Various Peakers
- Various Wind Farms
- Judd Units
- Dean Units

At 230 kV

- DIG Units

At 345 kV

- Belle River Units #1 & 2 and three Belle River Peakers
- Enrico Fermi Unit #2
- Greenwood Unit #1 and three Greenwood Peakers
- Monroe Units #1, 2, 3, & 4.
- St. Clair Units #6 & 7

2.4 OTHER PROSPECTIVE GENERATION

Four Units from earlier queued projects were also included in the models used to perform the impact study. The units included were as follows:

At 120 kV

- G503 Wind Farm

At 138

- G766 Wind Farm

At 345

- G687 Coal Plant

- G809 Expansion of Existing Coal

All earlier queued projects can be found on MISO's LGIP queue:

http://www.midwestmarket.org/publish/Document/2a74f7_108e84afbec_-74050a48324a

2.5 ITC*Transmission* – Hydro One Interface

The ITC*Transmission* interface with Hydro One (Canada) is planned to be controlled via four phase shifting transformers. In the past, these transformers have been normally modeled as controlling flow between ITC*Transmission* and Hydro One to 0 MW in ITC*Transmission* base case development. However, per the MISO transmission service process, it was determined that about 1107 MW of firm transmission reservations are available between ITC*Transmission* service territory and Canada. Because of this, it was necessary to model these firm reservations in the base models for this System Impact Study. It should be noted that these firm reservations are also now being modeled in MISO's base case development for there MTEP (Midwest ISO Transmission Expansion Planning) process.

2.6 Intermediate Load Analysis

At 85% of peak load, ITC*Transmission*'s criterion requires the ability to take the shutdown of one piece of equipment and be able to withstand any single contingency. Because of this, it was necessary to also analyze the system for off peak conditions.

80% peak load cases were developed for the Intermediate Load analysis. These models were used for both the transient stability analysis and shut down plus contingency off peak thermal analysis. ITC*Transmission* system load was scaled down from 100% and imports into ITC*Transmission* from METC were scaled back to offset the decrease in loads. METC load was also scaled down to 80% if its peak value. Generation in METC was scaled down to match the lower load level.

3. Discussion of Results

3.1 Power Flow Evaluation

Thermal Loading

The performance of the existing ITC*Transmission* system was analyzed with the load flow models as described in Appendix C. Tables for all ITC*Transmission* peak and 80% cases thermal results can be found in Appendix D.

For all cases (system as planned for 2008) with the proposed Nuclear Plant operating at 100% capacity the following normal overloads would occur.

ITC*Transmission* Normal Overloads:

No normal overloads were identified on the ITCTransmission system for the addition of the G867 Nuclear Plant

ITC*Transmission* Emergency Overloads:

The circuits listed below become overloaded under various contingency scenarios (the worst single contingency overload is listed below for the ITC*Transmission* system).

1. Fermi to Brownstown #2 overloads to 113% of its emergency rating of 2333 MVA for the loss of Fermi to Brownstown #3, under peak load conditions.
2. Fermi to Brownstown #3 overloads to 131.2% of its emergency rating of 2007 MVA for the loss of Fermi to Brownstown #2, under peak conditions.

The ITCTransmission system modeled for the FCITC calculation assumed all the higher queued units in place, and the FCITC results may vary with changes to the queue. Based on the FCITC analysis of a transfer from the Nuclear plant to all units within the MISO system (excluding ITC), the 2008 ITCTransmission system modeled with 1107 MW in both directions on the ITCT to Canada interface and one dispatch scenario analyzed could support about 865 MW of generation from the Nuclear Plant in this study. This number strictly looks at limits on the ITCTransmission system, and neglects limits on the sub-transmission network. If sub-transmission limits are honored, the FCITC may be reduced.

Voltage Analysis

This analysis was performed using the peak load models with and without the new Nuclear Plant modeled. No new voltage criteria violations were identified with the aggregate Nuclear Plant generation added to the model. See Appendix E for further detail

Intermediate Load Analysis Sensitivity

Contingency analysis was performed with the 80% peak load model and the overloads are identified below. This included testing the ITC*Transmission* system for ITC*Transmission's* shut down plus contingency criteria. See Appendix F for further detail.

1. The Brownstown 345/230 kV transformer 302 overloads to 131% of its emergency rating of 858 MVA for the shutdown plus contingency of Fermi to Brownstown #3 and Victor to Lenox 120 kV, under 80% peak conditions.
2. Brownstown to Elm overloads to 106.7% of its emergency rating of 853 MVA for the shutdown plus contingency of Brownstown transformer #304 and Fermi to Brownstown #3, under 80% peak conditions.
3. The Brownstown 345/120 kV transformer 304 overloads to 106.6% of its emergency rating of 700 MVA for the shutdown plus contingency of Fermi to Brownstown #3 and Brownstown to Elm/Rotunda, under 80% peak conditions.

3.2 CIRCUIT BREAKER DUTY EVALUATION (SHORT CIRCUIT)

A comparison of circuit breaker fault duty of the currently planned ITC*Transmission* system vs. the planned system including the proposed Nuclear Plant and all system enhancements identified as necessary in the thermal and voltage analysis sections of this report was performed. No breakers on the ITCTransmission system violated their interrupting capability with the new generator and system upgrades in place.

3.3 SYSTEM STABILITY EVALUATION

The 2017 ITC*Transmission*/METC 80% peak load case was adopted in the stability study. This case was developed by inserting 2017 ITC*Transmission*/METC 80% peak load and system conditions into 2006 series MMWG/ECAR case. The 2017 ITC*Transmission*/METC 80% peak load case simulated the distribution system in detail. The study analyzed the system dynamic performance at two possible extreme ends of the power factor range for Enrico Fermi nuclear plant, 0.92 lagging and 0.93 leading as measured at the high voltage side of Enrico Fermi2 22/345 kV GSU2A2B and Enrico Fermi3 27/345 kV GSU3A3B. The future Enrico Fermi nuclear plant includes existing 1148 MW Enrico Fermi2 unit and proposed 1563 MW Enrico Fermi3 unit

The load flow cases for 0.92 lagging power factor condition and 0.93 leading power factor condition were summarized in *Appendix L*. The machine terminal voltages of Enrico Fermi2 and Enrico Fermi3 units were set at lower levels but not below 0.95 PU and at full electrical power output. In general, this is the least stable condition for a generating machine.

It was shown in *Appendix L* that two load flow cases were tested for 0.93 leading power factor condition, the first case is that Enrico Fermi3 27 kV voltage was set to be 0.9588 PU and the second case is the voltage was set to be 0.9733 PU. The stability faults were tested around the switchyards of Enrico Fermi3 345 kV, Milan 345 kV, Enrico Fermi2 345 kV, Brownstown 2 345 kV and Brownstown 3 345 kV. The breaker/relay configurations for the above switchyards were presented in *Appendix B*.

The detailed descriptions of the stability fault scenarios were tabulated in *Appendix M* and the stability simulation results were summarized in *Appendix N*. The dynamic simulation plots were presented in *Appendix O* for 0.92 lagging power factor condition and in *Appendix P* for 0.93 leading power factor case. For 0.93 leading power factor condition, the plots for Double-Phase to Ground Faults with Delayed Clearing due to Stuck Breaker were the simulation results for the case when Enrico Fermi3 27 kV voltage was set to be 0.9733 PU and the plots for the rest stability faults were for the case when Enrico Fermi3 27 kV voltage was set to be 0.9588 PU as shown in *Appendix L*.

The following variables were monitored in the dynamic simulations:

1. The generator Rotor Angle in Degrees, Shaft Speed Deviation in PU, Terminal Voltage in PU, Real/Reactive Power Output in 100 MW/100 MVAR for the selected generating units of Enrico Fermi2, Enrico Fermi3, Monroe 1, Monroe 3, Trenton Channel 9 and Judd 1.
2. The Bus Voltage in PU for the selected 345 kV buses of Enrico Fermi2, Enrico Fermi3, Milan, Brownstown 2 and Brownstown 3, as well as the 120 kV bus of Enrico Fermi.

In conclusion, the stability simulation results conducted following the ITC*Transmission* transmission planning criteria do not indicate that the proposed Enrico Fermi3 unit will post significant adverse impacts on the dynamic performance of Enrico Fermi2 unit and ITC*Transmission* transmission system. Enrico Fermi3 unit can maintain its stability for all the tested stability contingencies on the designed breaker/relay configurations and schemes around Enrico Fermi3, Milan, Enrico Fermi2, Brownstown 2 and Brownstown 3 345 kV switchyards shown in *Appendix B*. The observations and recommendations drawn from stability study results are summarized as follows:

1. The existing Majestic to Lemoyne 345 kV line must be looped into Milan 345 kV switchyard. Combining with the existing Milan to Majestic 345 kV line and Milan to Lulu 345 kV line, this will provide strong and needed interconnection support to Ernico Fermi 3 unit to maintain its stability.
2. The operational restriction for Enrico Fermi3 27 kV is that the operational voltage can not be dropped below 0.975 PU. The simulation results showed that if the voltage is set to be 0.9588 PU under 0.93 leading power factor condition, for the double-phase to ground fault at Milan to Lulu 345 kV CKT 1 with delayed clearing due to stuck breaker CF or CM at Milan 345 kV switchyard, Enrico Fermi3 unit can not maintain its stability. The instability simulation plots were shown in *Appendix Q*.
3. There must be three lines connected Enrico Fermi3 345 kV switchyard to Milan 345 kV switchyard. If there were only two lines, then for the double-phase to ground faults with delayed clear due to stuck breaker at Enrico Fermi3 345 kV switchyard or at Milan 345 kV switchyard that tripped anyone of the two Enrico Fermi3 to Milan 345 kV lines, Enrico Fermi3 unit became unstable.
4. Any two of the three Enrico Fermi3 to Milan 345 kV lines can not be in the same row/column at Enrico Fermi 345 kV switchyard or Milan 345 kV switchyard that separates the two lines by only one breaker. This is to avoid the instability situation for Enrico Fermi3 unit if two Enrico Fermi3 to Milan 345 kV lines were tripped by double-phase to ground fault with delayed clear due to stuck breaker at Enrico Fermi3 345kV switchyard.
5. Milan to Lulu 345 kV CKT 1 can not be in the same row/column at Milan 345 kV switchyard with Milan 345/120 kV XFMR or Milan to Enrico Fermi3 345 kV lines or Milan to Majestic 345 kV lines that separates the two lines by only one breaker. Milan to Lulu 345 kV line carried a significant amount of reactive power from Monroe power plant into Milan to support Enrico Fermi power plant operating at 0.93 leading power factor conditions. Enrico Fermi3 unit became unstable if Milan to Lulu 345 kV CKT 1 plus any of the above lines/XFMR were tripped by double-phase to ground faults with delayed clear due to stuck breaker at Milan 345 kV.
6. Anyone of the two Milan to Majestic 345 kV lines can not be in the same row/column with anyone of the three Milan to Enrico Fermi3 345 kV lines at Milan 345 kV

switchyard that separates the two lines by only one breaker. Enrico Fermi3 unit became unstable if one Milan to Majestic 345 kV line plus one Milan to Enrico Fermi 3 345 kV line were tripped by double-phase to ground faults with delayed clear due to stuck breaker at Milan 345 kV.

7. Enrico Fermi3 unit initial constant (H) data supplied by the customer ranges from 4.84 to 6.00 kW sec/kVA. In the stability simulation, 4.84 kV sec/kVA was selected as the initial constant for Enrico Fermi3 unit to represent the least stable condition for a generating machine. The simulation results showed that although larger initial constant (H = 6.00 kW sec/kVA) did increase the stability margin of Enrico Fermi 3 unit, it was not sufficient to reverse the observations, recommendations and conclusions drwan from the stability study.

The stability study contained in this report was performed with the assumed data suggested by the customer. Actual machine and other equipment parameters do vary and can have an impact on performance not witnessed in the stability study results. Future situations that differ from the assumptions contained in this report may affect the observations, recommendations and conclusions. ITC*Transmission* makes no guarantee that these or other factors not foreseen during the study will not impact the proposed observations, recommendations and conclusions.

4. GOOD FAITH ESTIMATE OF FACILITY UPGRADES – ITC*TRANSMISSION*

Implementing system upgrades can alter the flows on and between the transmission and subtransmission systems. For this reason, testing solutions for criteria violations can be an iterative process. The upgrades discussed in this section are an estimation of the upgrades that may be required in order to mitigate all of the thermal, voltage, short circuit, and/or stability violations discussed above. It is possible that a different set of upgrades may ultimately be implemented to address the identified overloads. This will depend on several factors including any unforeseen network changes that occur before the 2017 In-Service Date of the Nuclear Plant.

Because the total power produced by the proposed Nuclear Plant exceeds the capability of the existing 345 kV system and the underlying 230 kV and 120 kV systems in the area of the ITC*Transmission* footprint, transmission upgrades would be necessary in order to facilitate the maximum capability of the proposed Nuclear Plant. System upgrades would include constructing the 345 kV Fermi #3 switchyard, building 3 new 345 kV circuits from the Fermi #3 switchyard to Milan Station, cutting the existing Lemoyne-Majestic 345 kV line into Milan station, and expanding Milan to accommodate the additional lines.

A non-binding high level estimate for the necessary system upgrades would come in at around $97.1M. See Appendix H for further detail. This estimate however is subject to change depending on actual system enhancements required, timing of the project, and actual equipment costs at the time the project would start. It is estimated that the system enhancements would take up to 36 months to complete and would depend on various issues including but not limited to; securing the necessary rights-of-way, equipment availability and deliverability lead times, other maintenance or construction schedules, weather, outage requirements, and possibly generator availability. Construction of the proposed system upgrades would require extended outages that will be very difficult to obtain and coordinate.