System Restoration Strategy

1) Matrix Item #4 – Determine Quantity and Size of Black Start Generation
   a) Change the Critical Load Definition in Attachment A or M-36 to include only Critical Steam (<8 hour start) Auxiliary Load.
      i) To allow for redundancy, 125% of this total load will be used to determine the Tier 1 Critical Black Start requirement for each zone. (See 2-a-i)
      ii) This will be the minimum amount of Black Start required for RTO restoration.
   b) Maintain priority of restoration of Nuclear off-site safe shutdown power and critical gas infrastructure load in Restoration Plan
      i) Maintain a 4 hour target restoration time for this load.
      ii) This load can be supplied by Tier 1 Black Start generation, Tier 2 Black Start generation or other non-Black Start generation.
         (1) The total nuclear aux-safe shutdown load and Gas infrastructure load will be calculated.
         (2) An analysis will determine if enough generation would be available within 4 hours to meet the 4 hour load restoration target.
         (3) Additional Tier 1 or Tier 2 Black Start will be acquired to meet these timeframes if necessary.

2) Matrix Item #3 – Black Start requirements considering number, availability and location of Black Start; Matrix Item #6 Classification of Black Start Generators
   a) Define 2 Black Start products – Tier 1 and Tier 2
      i) Tier 1 Black Start units are units that meet the existing definition and requirements of a Black Start unit. (90 minute or less start)
         (1) The Tier 1 Black Start requirement is based on 125% of Critical Steam Auxiliary Load.
      ii) A Tier 2 Black Start unit would have the same requirements as a Tier 1 Black Start unit except the time to start can be up to 4 hours.
         (1) PJM will not identify a minimum requirement for Tier 2 Black Start.
         (2) PJM will compensate up to the total of Critical Steam Aux Load, Nuclear off-site power and critical gas infrastructure load (minus the total Tier 1 BS Generation)
            (a) Example: In a given zone:
               Critical Steam Aux Load = 30 MW
               Nuclear off-site power = 40 MW
               Critical Gas Infrastructure Load = 25 MW
               Tier 1 Black Start requirement = 30 MW
               Maximum Tier 2 compensated = (95 MW – 30 MW) = 65 MW
   b) PJM would ensure a minimum of one Tier 1 Black Start unit would be available for each transmission zone.
      i) The current exception process would be retained for zones with no generation. The Black Start requirement in a zone with no Critical Steam generation will be zero.
ii) Tier 1 Black Start generation physically located in one transmission zone may supply Critical Load in another zone through agreements between the zones and PJM and documented in Restoration Plans.

If there are Black Start shortages in a zone, PJM will have the ability to aggregate zones for the purposes of the Tier 1 Black Start requirements. These aggregations will be reflected in both TO and PJM Restoration plans.

c) Relax Remove the current restriction on only 3 Black Start units per location.

d) Transmission Owners may nominate additional Tier 1 or Tier 2 Black Start Units (above the PJM minimum amounts).

i) This additional Black Start would be acquired through bilateral contracts between the TO and Generation Owner.

ii) PJM will evaluate the justification, with stakeholder input, for this additional Black Start and make the determination of compensation. Any additional Black Start above PJM minimum levels will be charged to load in the applicable zone.

iii) Bilateral contracts would specify testing and all operational requirements for these Black Start units.

iv) Compensation methods would be between the two parties outside the PJM process.

3) Matrix Item #5 – Black Start requirements considering restoration time

a) Target System Restoration timeframe from a complete blackout with no outside assistance available within a 24 to 48 hour window.

i) Analyze restoration timeframes given Black Start generation with the EPRI software.

ii) If restoration timeframe falls outside of the 24-48 hour range for the RTO, this would could justify acquiring more or less Black Start generation.

iii) Utilize EPRI analysis to determine most optimal location of additional Black Start if overall restoration time exceeds 48 hours.

4) Matrix Item #7 – Initial Restoration Assumptions

a) Develop System Restoration plans for worst case scenario of complete blackout with no outside assistance.

5) Matrix Item #8 – Restoration Strategy Alternatives

a) Maintain TO based Restoration Plans but allow for Black Start to be supplied from neighboring zones where it makes sense. Incorporate Black Start sharing into TO and PJM Restoration Plans as required.

6) Matrix Item #9 – Alternate technology for Black Start

a) Any resource capable of meeting the Black Start requirements is eligible to be considered as a Black Start resource.

7) Matrix Item #10 – Entity responsible for identification of Black Start quantity and location
a) PJM, with TO assistance, would identify the Tier 1 Black Start units (minimum requirement).

b) TO may nominate additional Black Start generation. **PJM will evaluate the justification with stakeholder input.**
Process for Acquiring Black Start Generation

Note: Method of acquisition is yet to be determined

**Stage 1**
1) PJM will calculate the amount of Critical Steam (<8 hour start) Auxiliary load within each TO zone. This will set the Stage 1 load requirements.
2) Stage 1 loads must be met with Tier 1 BS generation.
3) PJM (with TO assistance) will acquire enough Tier 1 Black Start generation in each zone to meet this Critical Steam requirement.
   a. If a zone has no Critical Steam, that zone’s Tier 1 BS requirement will be zero.
   b. PJM will ensure a degree of fuel diversity and pipeline diversity (for gas units) so that all BS units in the RTO are not of the same fuel or supplied by the same pipeline.

**Stage 2**
1) PJM will calculate the amount of Nuclear safe shutdown load and Gas infrastructure load within each TO zone. This will set the Stage 2 load requirements.
2) Stage 2 loads may be met with Tier 1 BS, Tier 2 BS or non-BS generation, but have a 4 hour timeframe.
3) PJM (with TO assistance) will analyze if enough generation will be available within 4 hours (from Tier 1 BS and Critical steam; Stage 1) to meet these load requirements.
   a. If insufficient generation will be available within 4 hours to meet the nuclear and gas loads, then PJM will acquire additional Tier 2 BS to meet these requirements.
      i. If no Tier 2 BS is available within a zone, then PJM will acquire additional Tier 1 BS within the zone to meet these loads.
      1. If there is insufficient Tier 1 and Tier 2 within a zone to meet the Stage 2 load, then PJM will look to acquire either Tier 1 or Tier 2 BS from outside the zone or consolidate zones.
   b. If sufficient generation will be available within 4 hours to meet the Stage 2 load requirements, no additional BS generation is required.

**Stage 3 (Future?)**
1) PJM will take the total Tier1 and Tier 2 BS units in each zone and use them as inputs into the EPRI analysis to determine the overall restoration time.
2) If the total time is less than 48 hours, no additional BS commitments will be made.
3) If the total time exceeds 48 hours, PJM will analyze if there are additional BS units that could be committed to bring the restoration time down to 48 hours.
Stage 4
1) If a TO desires additional BS, they will nominate additional BS units.
   a. This additional BS will be established through bilateral contracts between the TO and BS unit owner.
   b. These contracts will establish the requirements on the BS generator.
   c. The contract will specify the compensation method for the BS generator.
      i. Compensation will be between the TO and the BS unit owner (outside the PJM process)
Advantages to Proposal
1. Defines a Tier 2 BS product which should increase amount of BS generation available.
2. Lowers Tier 1 BS requirement by only using BS generation for the main purpose of starting additional generation.
3. Maintain criticality (4 hour restoration time) of Nuclear safe shutdown and gas infrastructure load.
4. Allows for pooling of BS resources between zones
5. Based on goal of restarting generation quickly.
6. Meets all NERC reliability standards
7. Provides for an analysis to better determine overall RTO restoration time.
8. Allows TO to directly contract for additional BS generation if desired.