# Summary of Cost Development Subcommittee Revised Start-Up Cost Package

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May 25, 2022

**Key Work Activities and Scope**

Provide detailed guidance and updates as necessary in Manual 15 for:

1) Calculation of start-up cost based offers for steam units, combustion turbine units (CT), combined cycle units (CC), and diesel units including:
   a. Allowable components in the start-up cost calculation,
   b. Costs for multi-block combined cycle units including how to value CT generation if applicable,
   c. Rules for aggregated combustion turbines or diesels,
   d. And discussion of additional labor costs during start-up.
2) Discuss consistency of start-up cost parameters with start-up and notification times.
3) Review and confirm unit types currently in M15 limited to zero start-up costs.
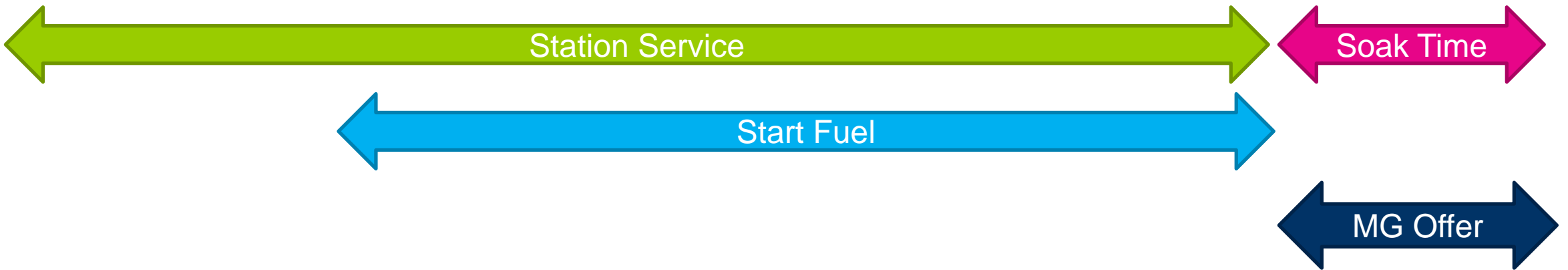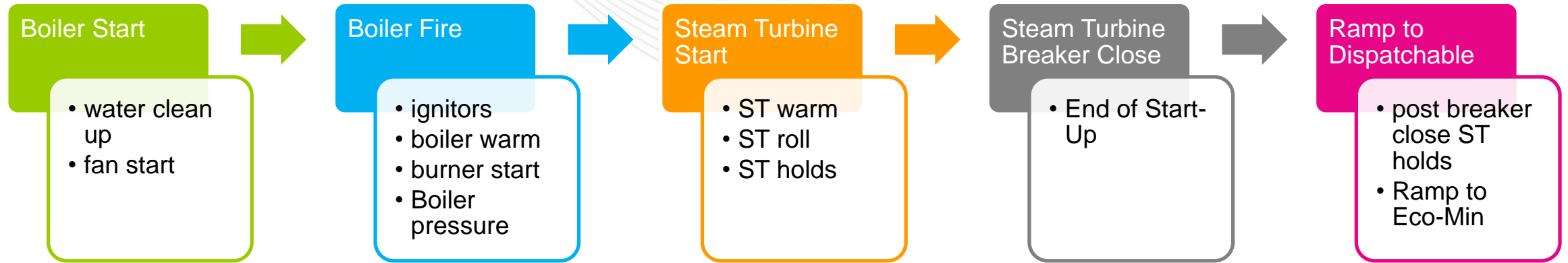
- CDS initially brought two packages for first reads to the MIC in October and November of 2021
  - PJM/IMM Package
  - Clarification Package
- Voting on the Packages was postponed so that the CDS could have further discussion on reaching a consensus package. The two original packages have been withdrawn and there is only one package being brought forth for MIC consideration
  - Revised PJM/IMM Package
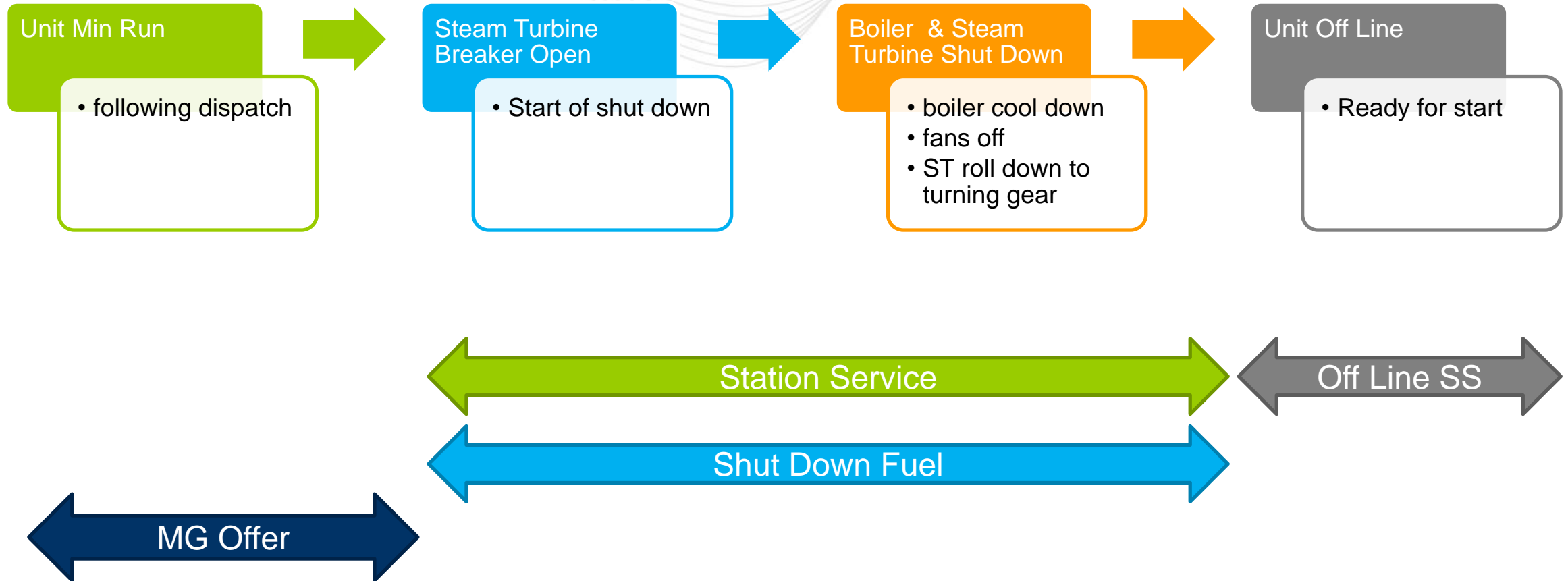
- For units without a soak process (combustion turbines, reciprocating engines), Start-Up Cost include costs from PJM notification to first breaker close and from last breaker open to shutdown (Status Quo).

- For units with a soak process (steam, combined cycle, nuclear) Start-Up Cost include costs from PJM notification to dispatchable output and from last breaker open to shutdown.

- The Revised PJM/IMM Package proposes a number of other changes to M15 to provide additional guidance and/or clarification on:

  - equation to calculate Start-Up Cost

  - station service calculations for units with and without a soak process

  - calculation of net generation for units with soak process

  - Unit specific parameter limits on includable costs

  - start maintenance adder

  - removal of start additional labor cost

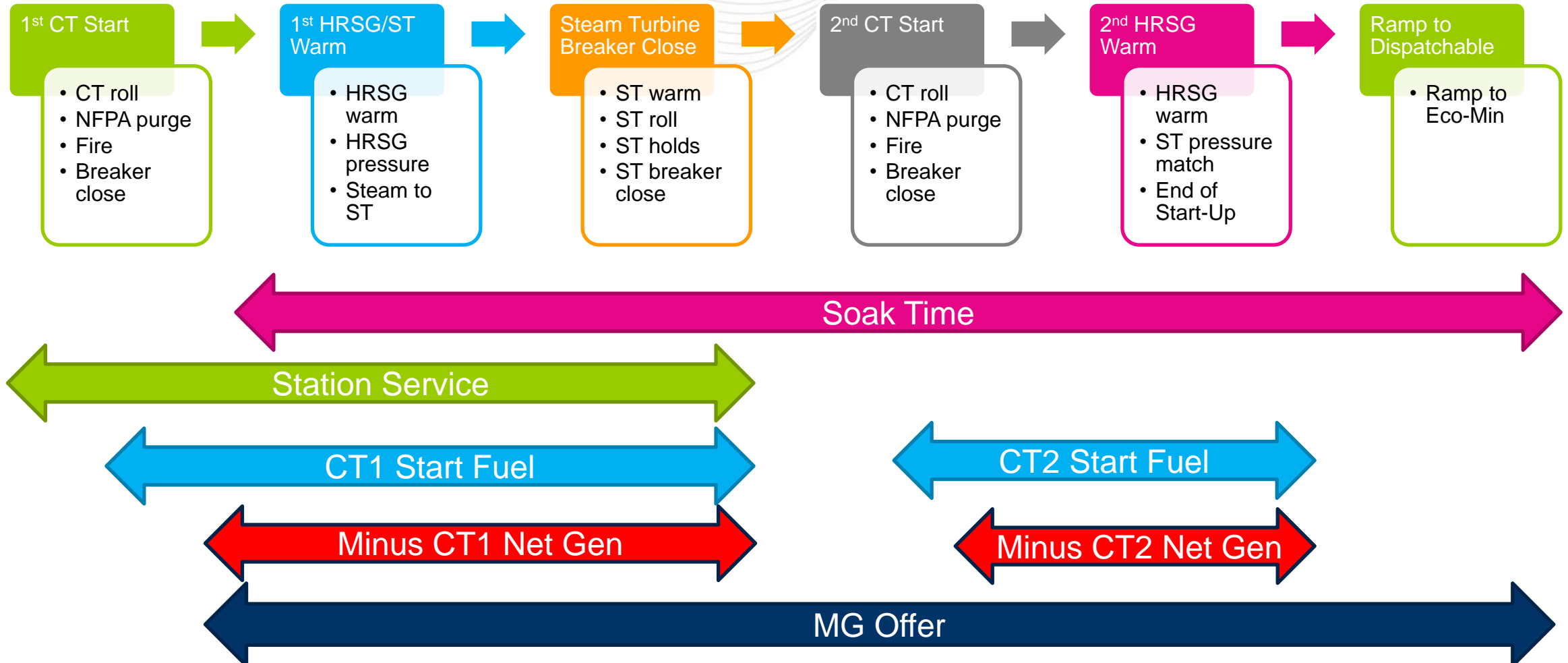  - Start costs for aggregated, pseudo-tied, and cogeneration units

- Open Access Transmission Tariff –
  - Definitions
  - Attachment K Appendix Section 6.4
- Operating Agreement
  - Definitions
  - Schedule 1 Section 6.4
  - Schedule 2
- Manual 15 Cost Development Guidelines

- M15 currently allows combined cycle units to includes fuel cost after generator breaker closure and synchronization to the grid in their calculation of Start-Up Costs that other unit types such as steam and nuclear cannot.

- Proposed revisions will align Start-Up Cost all units with a soak process (steam turbines).

- Allow units to include soak cost in Start-Up Cost. Note to avoid double compensation, such units will not be made whole for MWh while soaking.

**Boiler Start**
- water clean up
- fan start

**Boiler Fire**
- ignitors
- boiler warm
- burner start
- Boiler pressure

**Steam Turbine Start**
- ST warm
- ST roll
- ST holds

**Steam Turbine Breaker Close**
- End of Start-Up

**Ramp to Dispatchable**
- post breaker close ST holds
- Ramp to Eco-Min

← Station Service →

← Soak Time →

← Start Fuel →

← MG Offer →

**Unit Min Run**
- following dispatch

**Steam Turbine Breaker Open**
- Start of shut down

**Boiler & Steam Turbine Shut Down**
- boiler cool down
- fans off
- ST roll down to turning gear

**Unit Off Line**
- Ready for start

Station Service

Off Line SS

Shut Down Fuel

MG Offer

# Current 2x1 Combined Cycle Unit Start-Up

**1st CT Start** →
- CT roll
- NFPA purge
- Fire
- Breaker close

**1st HRSG/ST Warm** →
- HRSG warm
- HRSG pressure
- Steam to ST

**Steam Turbine Breaker Close** →
- ST warm
- ST roll
- ST holds
- ST breaker close

**2nd CT Start** →
- CT roll
- NFPA purge
- Fire
- Breaker close

**2nd HRSG Warm** →
- HRSG warm
- ST pressure match
- End of Start-Up

**Ramp to Dispatchable**
- Ramp to Eco-Min

← Soak Time →

← Station Service →

← CT1 Start Fuel →   ← CT2 Start Fuel →

← Minus CT1 Net Gen →   ← Minus CT2 Net Gen →

← MG Offer →

# Current 2x1 Combined Cycle Unit Shut Down

**Unit Min Run**
- following dispatch

**Steam Turbine Breaker Open**
- Start of shut down

**CT1 and CT2 Breaker Open**
- HRSG cool down
- ST roll down to turning gear

**Unit Off Line**
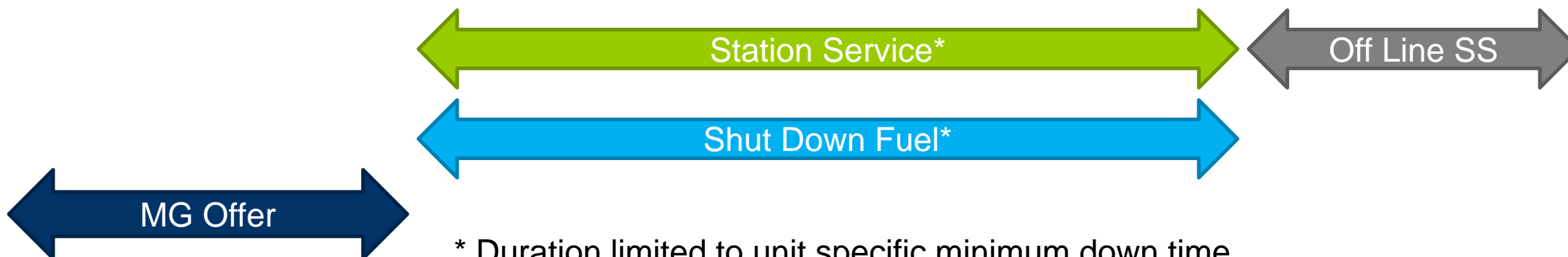- Ready for start

Station Service

Off Line SS

Shut Down Fuel

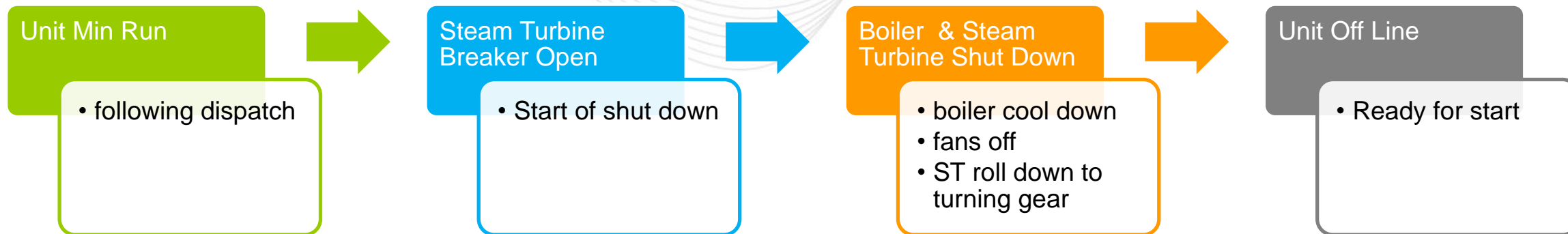Minus CT Net Gen

MG Offer
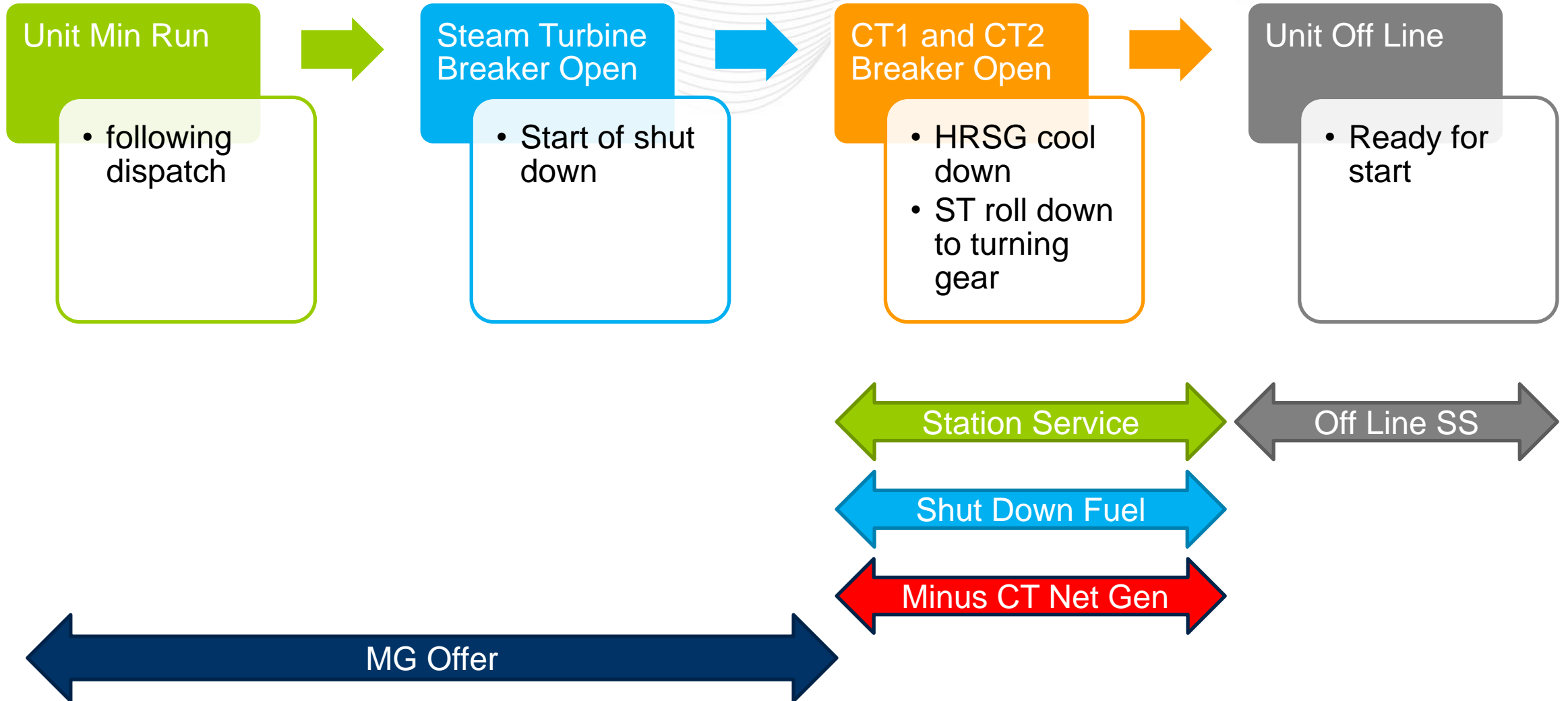
- The Revised PJM/IMM Package proposes to revise M15 calculations for Start-Up Cost, start fuel and station service to be consistent for all unit types with a soak process (steam turbine) and simplify the calculation of the net generation offset.
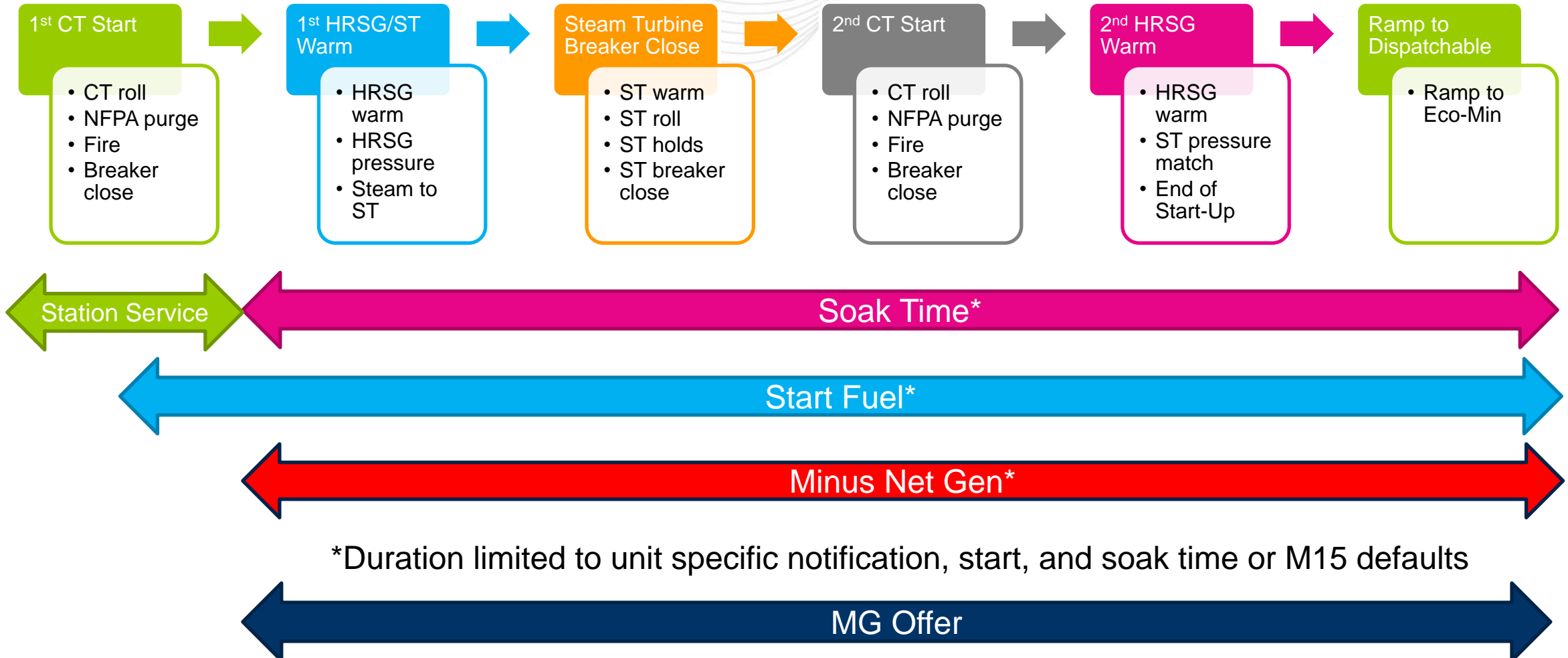
**Boiler Start**
- water clean up
- fan start

**Boiler Fire**
- ignitors
- boiler warm
- burner start
- Boiler pressure

**Steam Turbine Start**
- ST warm
- ST roll
- ST holds

**Steam Turbine Breaker Close**
- End of Start-Up

**Ramp to Dispatchable**
- post breaker close ST holds
- Ramp to Eco-Min

Station Service

Soak Time*

Start Fuel*

Minus Net Gen*

MG Offer
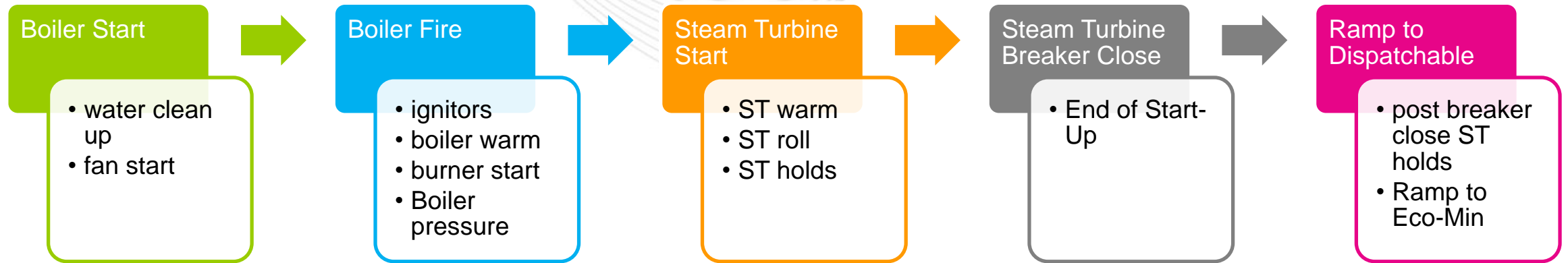
\* Duration limited to unit specific notification, start, and soak time or M15 defaults

**Unit Min Run**
- following dispatch

→

**Steam Turbine Breaker Open**
- Start of shut down

→

**Boiler & Steam Turbine Shut Down**
- boiler cool down
- fans off
- ST roll down to turning gear

→

**Unit Off Line**
- Ready for start

← Station Service* → ← Off Line SS →

← Shut Down Fuel* →

← MG Offer →

\* Duration limited to unit specific minimum down time minus unit specific hot start time

**Unit Min Run**
- following dispatch

**Steam Turbine Breaker Open**
- Start of shut down

**CT1 and CT2 Breaker Open**
- HRSG cool down
- ST roll down to turning gear

**Unit Off Line**
- Ready for start

← Station Service* →  ← Off Line SS →

← Shut Down Fuel* →

* Duration limited to unit specific minimum down time minus unit specific hot start time

← MG Offer →

**First Engine Fire**
- Beginning of Start-Up

**First Breaker Closure**
- End of Start-Up

**Second Breaker Closure**
- Additional Engine Start-Ups

**Last Breaker Closure**
- End of Engine Start-Ups

**Ramp to Dispatchable**
- Ramp to Eco-Min

Station Service

Start Fuel*

* Duration limited to unit specific notification and start time

MG Offer

**Unit Min Run**
- following dispatch

**(All) Engine Breakers Open**
- Start of shut down

**Engines Shut Down**
- cool down
- turning gear

**Unit Off Line**
- Ready for start

Station Service*

Off Line SS

Shut Down Fuel*

MG Offer

\* Duration limited to unit specific minimum down time minus unit specific hot start time
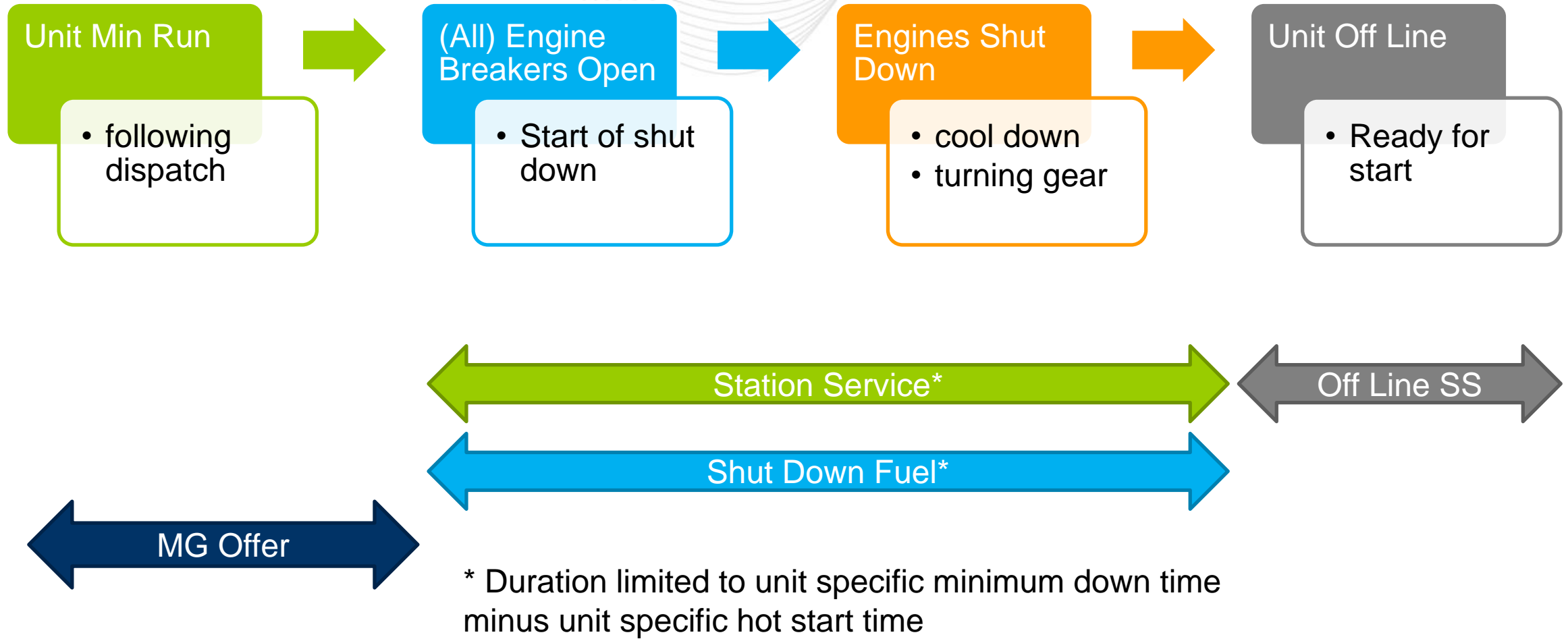
- Start Cost shall mean the unit costs to bring the boiler, turbine and generator from shutdown conditions to the point after breaker closure which is typically indicated by telemetered or aggregated state estimator megawatts greater than zero and is determined based on the cost of start fuel, total fuel-related cost, performance factor, electrical costs (station service), start maintenance adder, and additional labor cost if required above normal station manning.  Start-up Costs can vary with the unit offline time being categorized in three unit temperature conditions: hot, intermediate and cold.

**Start-Up Costs:**

"Start-Up Costs" shall consist primarily of the cost of fuel, as determined by the unit's start heat input (adjusted by the performance factor) times the fuel cost. It also includes operating costs, Maintenance Adders, emissions allowances/adders, and station service cost. Start-Up Costs can vary with the unit offline time being categorized in three unit temperature conditions: hot, intermediate and cold.

For units with soak process: Start-Up Cost shall mean the net unit costs from PJM's notification to the level at which the unit can follow PJM's dispatch and from last breaker open to shutdown.

For units without soak process: Start-Up Cost shall mean the unit costs from PJM's notification to first breaker close and from last breaker open to shutdown. ~~mean the unit costs to bring the boiler,~~

## Start Fuel:

For units without a soak process, "Start Fuel" shall consist of fuel consumed from first fire of the start process to first breaker closing, plus any fuel expended from last breaker opening to shutdown.

For units with a soak process, "Start Fuel" is fuel consumed from first fire of the start process (initial reactor criticality for nuclear units) to the level at which the unit can follow PJM's dispatch (including auxiliary boiler fuel), plus any fuel expended from last breaker opening to shutdown, excluding normal plant heating/auxiliary equipment fuel requirements. Start Fuel included for each temperature state from breaker closure to the level at which the unit can follow PJM's dispatch shall not exceed the unit specific soak time period reviewed and approved as part of the unit-specific parameter process detailed in Tariff, Attachment K-Appendix, section 6.6(c) or the defaults below:
- Cold Soak Time = 0.73 * unit specific Minimum Run Time (in hours)
- Intermediate Soak Time = 0.61 * unit specific Minimum Run Time (in hours)
- Hot Soak Time = 0.43 * unit specific Minimum Run Time (in hours)

- **Station Service –**

  o **For units without soak process –** Station service consumed from PJM's notification to first breaker close and electricity consumed after last breaker open to shutdown above normal base station use. Normal base station service is the consumption prior to PJM's notification.

  o **For units with soak process –** Station service consumed from PJM's notification to first breaker close and electricity consumed after last breaker open to shutdown above normal base station use minus net generation produced from first breaker close to the level at which the unit can follow PJM's dispatch. Normal base station service is the consumption prior to PJM's notification.

- Currently, M15 Start-Up cost calculations allow generators to include additional labor cost in their Start-Up Cost.

- However, generators already get to include this type of cost in the unit's capacity offer via its Avoidable Cost Rate (ACR)

- The PJM/IMM Package proposes to eliminate this ambiguity by removing it from the OATT/OA Offer Cap,M15 Start-Up Cost calculation so all operating labor is includable in ACR.

- OA Schedule 2 Section 1.3 (a)

(a) For Start-up Costs
Fuel cost
Emission allowances/adders
Maintenance Adders
Operating Costs
Station service
~~Labor costs~~

- OATT Attachment K Appendix and OA Schedule 1 Section 6.4.3A (a)

Start-Up Cost component shall be evaluated for whether it exceeds the reasonably expected costs for that resource by applying the following formula:

Start-Up Cost ($) = [ [ (Performance Factor) x ( Start Fuel) x ( Fuel Cost ) ] + Start Maintenance Adder ~~+ Additional Start Labor~~ + Station Service Cost ] x (1 +A)

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