



Interstate Gas Pipeline Fundamentals

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PJM Electric Gas Coordination Senior Task Force

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Gas Pipeline Fundamentals

- Overview
- Line pack
- Operational Flow Orders
- Nominations, Scheduling and Confirmations

Gas Pipeline Fundamentals

- Shippers direct flows on the pipelines via their business arrangements
 - Nominations are a request for services subject to Scheduling and Confirmations
 - Scheduled Quantities are the result and are the basis for planning gas flows
 - Business delivery arrangements include LDCs, Industrial, Power Plants, Pipeline Interconnects
- Gas moves slowly compared to electricity
 - 15-25 mph
 - Line pack (inventory within pipeline) - simulates instantaneous movement if pipeline is set up properly – what comes in goes out
- Direct connected power plants are 0-40% of a pipeline's delivery demand
 - Most/all pipelines were built to connect gas supply to directly serve LDC/End users loads
 - Other reasons are for connectivity across the pipeline grid to connect to other pipelines
- Capacity is designed on a ratable basis – generally no spare is built in
 - If capacity is sold on a non-ratable basis as provided by some services it relies on line pack reservation to meet peak hour and duration of non ratable flow
 - Therefore, non ratable services use more capacity

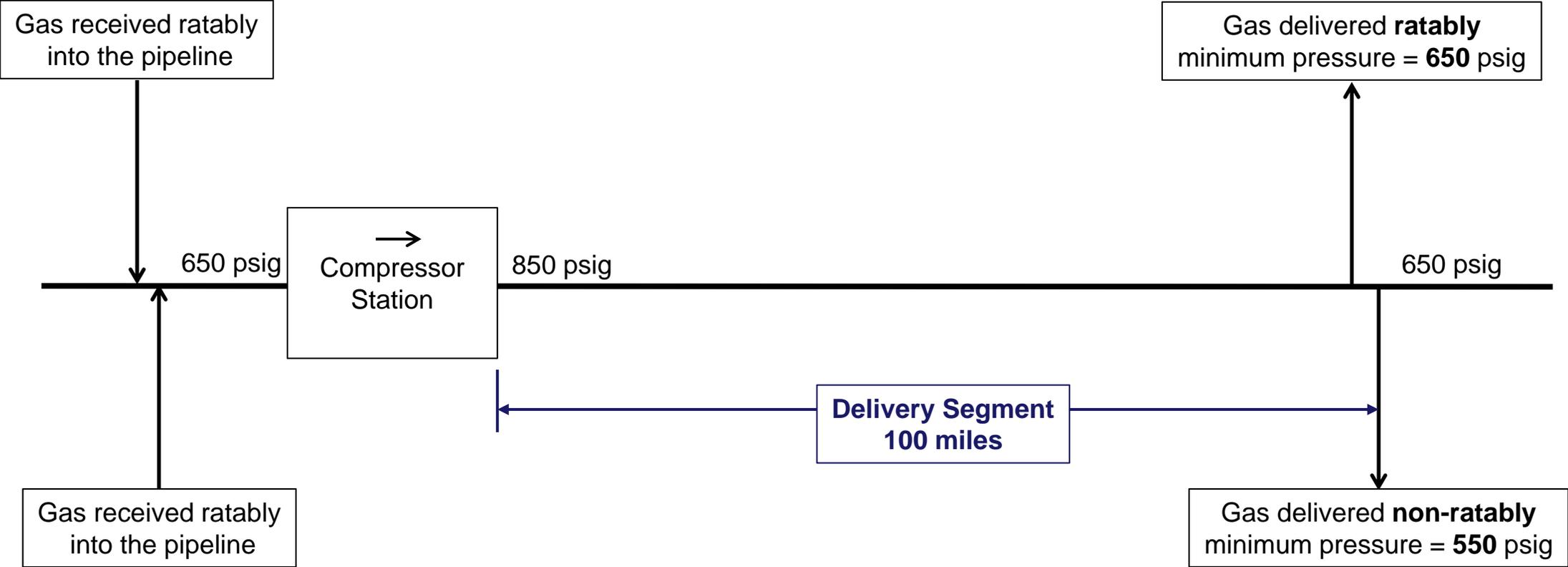
Gas Pipeline Fundamentals

- Many pipelines offer non ratable services if not at full capacity
 - Line pack needs to be reserved to make sure other deliveries are not impacted.
 - Meters are set to perform the 24 hr Scheduled Quantity, however upon agreement non-ratable flows can happen
 - Communication to interconnects, producers, end users and LDCs are key to keeping pipeline grid integrity and flexibility
 - Location specific
- Over takes by one can cause under takes by another
 - Recovery of line pack is not immediate because gas has to physically move
 - Flow control or economic incentives (OFOs) can be used if needed
 - OFOs are asking shippers to go back within tariff specs – NOT curtailments
- Generally no-notice Service can be offered if there is a combination of reserved pipeline and storage capacity
 - Does not give automatic non ratable rights

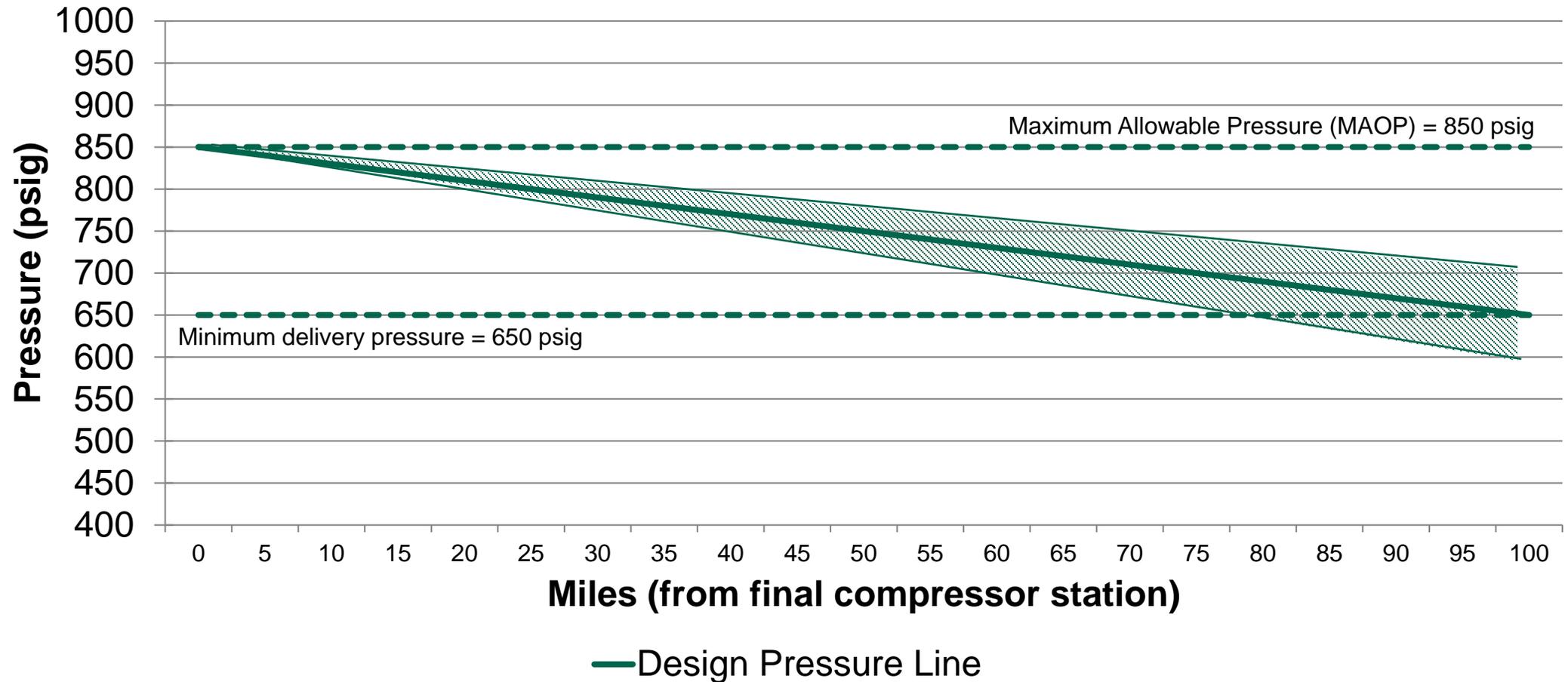
Line Pack

- Bounded by receipt and delivery pressures at max capacity
- Volume of natural gas that is packed and drafted to support operations
- Allows gas received in one area of a pipeline system to be delivered simultaneously elsewhere on the system
 - Adding gas at receipt point, without corresponding delivery, increases pressure (“packs” the line)
 - Removing gas at delivery point, without corresponding receipt, decreases pressure (“drafts” the line)
- Must be kept reasonably stable across entire system to preserve delivery pressure and system capacity
- Facilitates non-ratable flows during peak hours when pipeline is not flowing at max capacity
- Does not create incremental capacity
- Supports pipeline reliability by temporarily “buffering” unscheduled flows, resulting in imbalances
- No substitute for an appropriate transportation contract or for shipper supplying gas to the pipeline

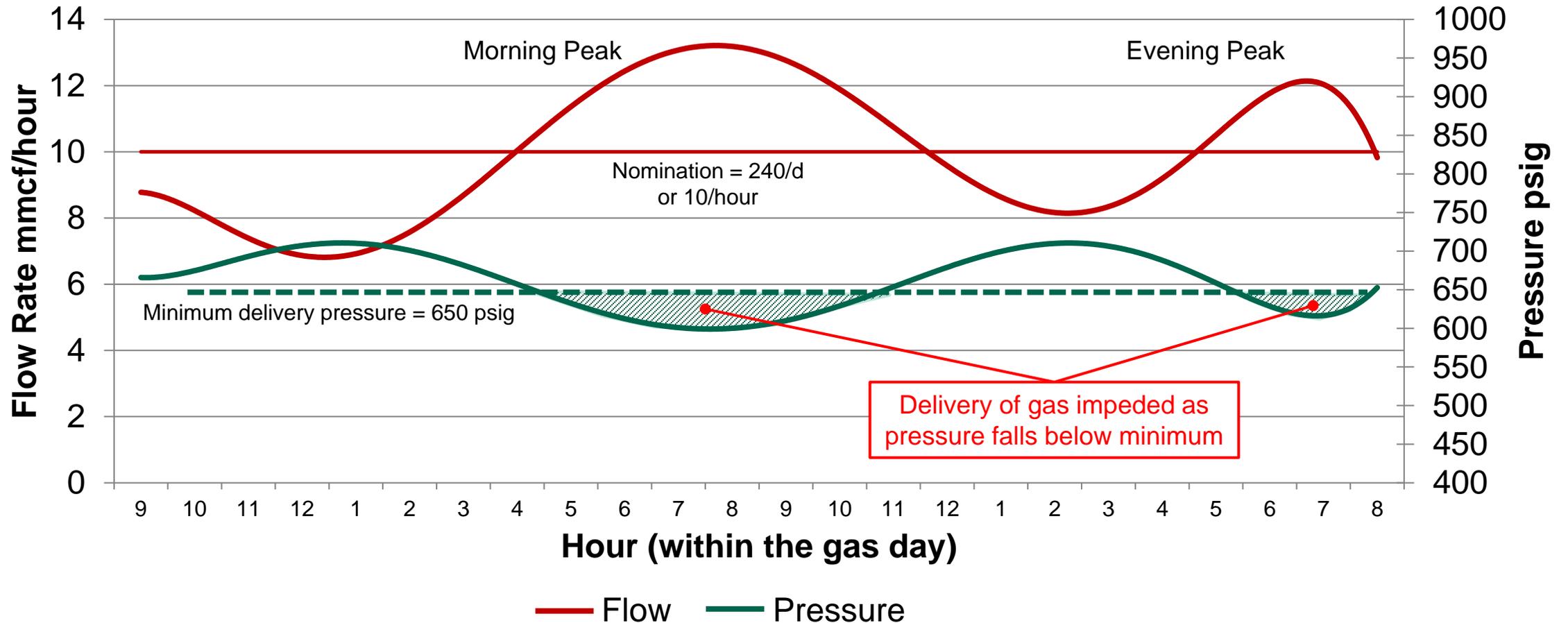
Line Pack -Basic Pipeline Design Schematic



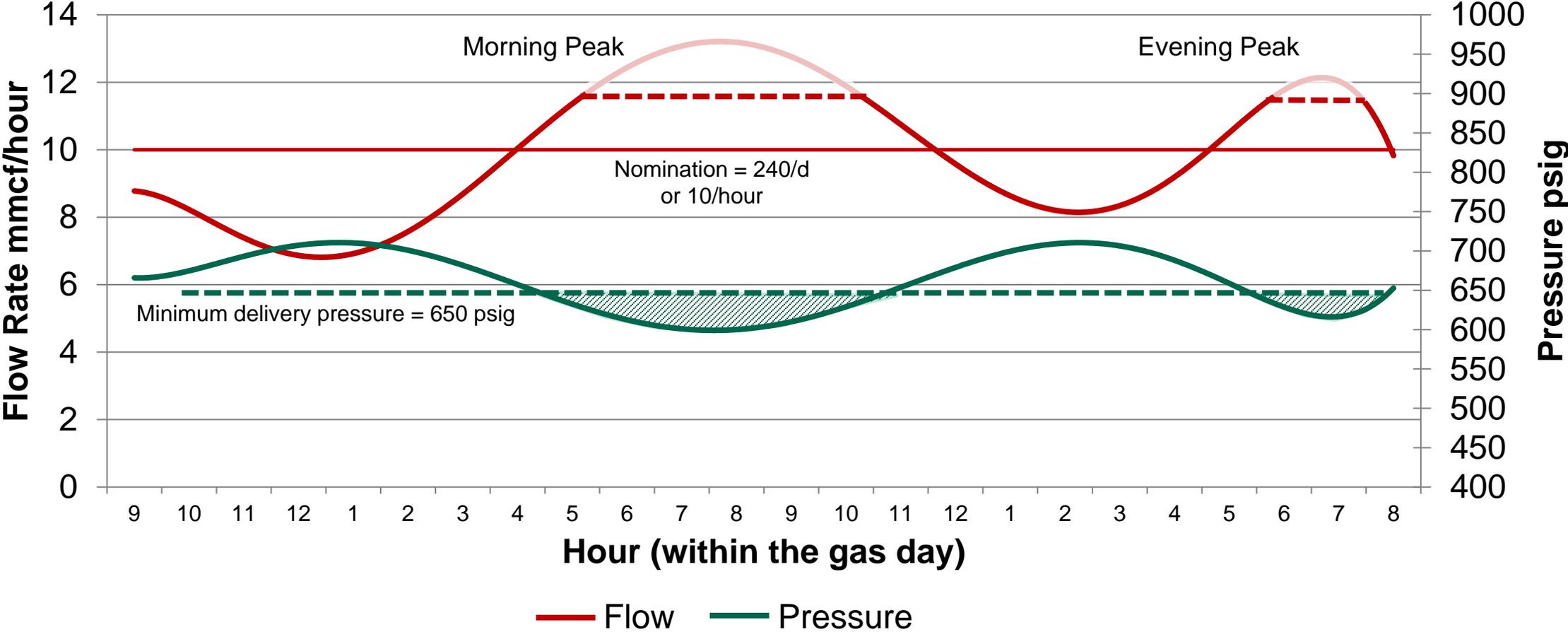
Line Pack - Operating Pressure Range (for the delivery segment)



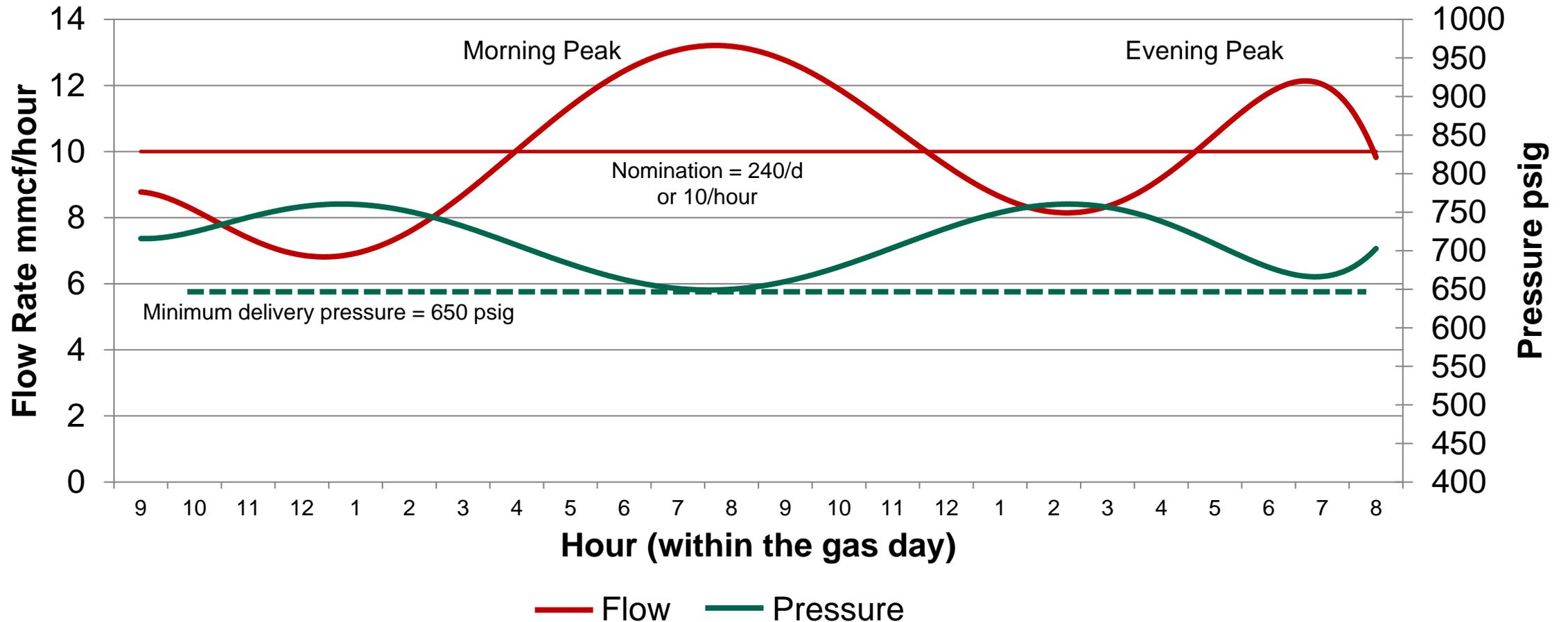
Line Pack - Delivery Pressure Falls Below Minimum Due to Non-Ratable Flow (if shipper's hourly takes exceed their rights)



Line Pack - Reliability Threatened During Peak Periods Due To Low Pressure (if shipper's hourly takes exceed their rights)



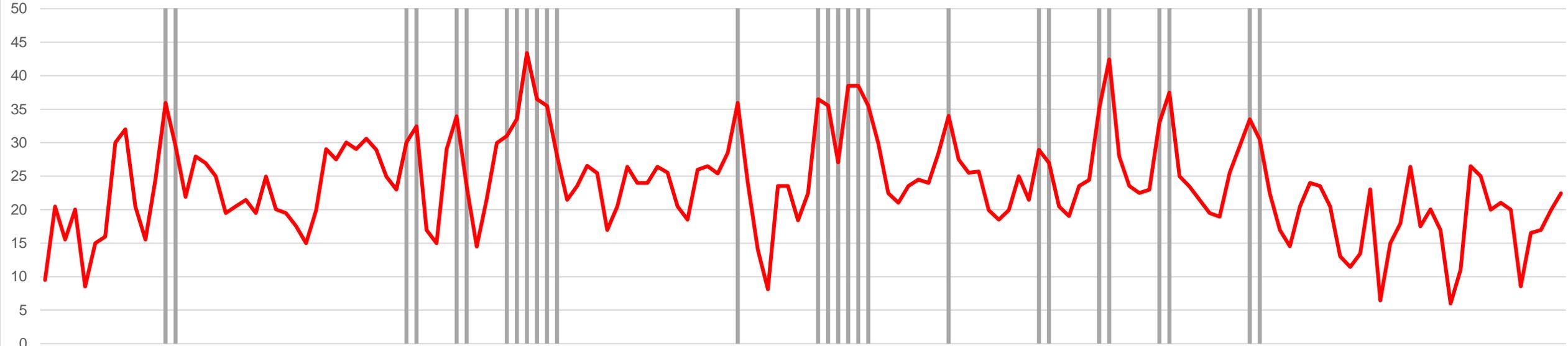
Line Pack - Non-Ratable Flow Can Be Provided During Peak With Appropriate Reserved Service



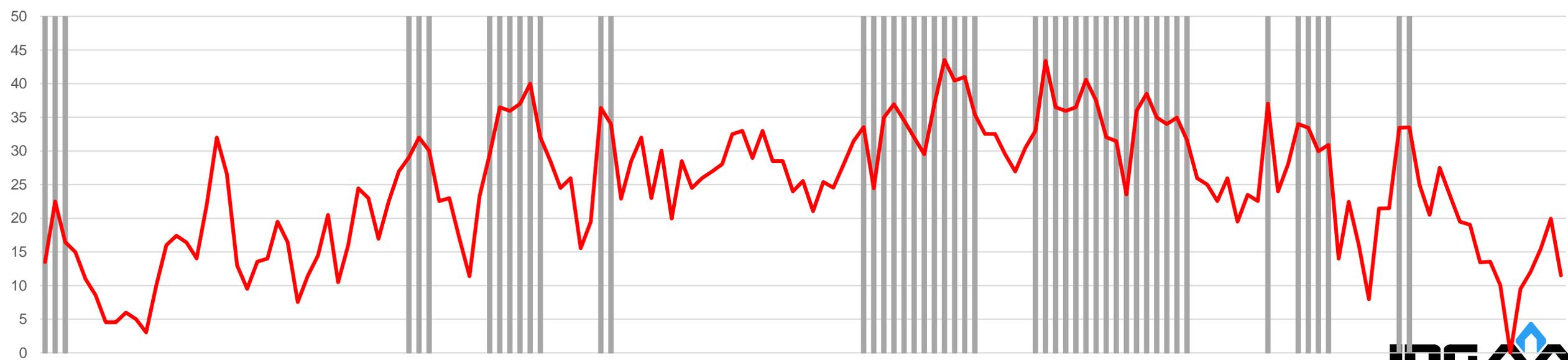
Operational Flow Orders (OFO)

- What – tariff defined provision that helps protect pipeline integrity and its firm services
 - This tool helps shippers who are in compliance with their activity to not be adversely impacted by shippers who are not
 - Specific issues are identified and directions for complying are posted to shippers/point operators.
 - Any penalties collected are not kept by the pipeline and are passed on to non-offending shippers
- Why – conditions occurring or forecasted that would put firm services at risk
 - OFOs generally telling shippers and point operators they should stay within their tariff defined rights
- When – advisory/warnings are issued if possible
 - Primarily weather events in which shipper utilization is expected to be high driving pipe to max capacity
- Where – not necessarily the entire system, only where needed
 - Geographical to the area of concern
- Who – all parties with scheduled deliveries no matter what service
 - Can impacts shippers and point operators
- Summary – pipelines only call when necessary
 - Higher shipper utilization of capacity, often means less flexibility
 - Pipeline maintenance or force majeure are primarily managed by scheduling down nominations to meet a lower available capacity

Correlation between Degree Days and OFOs - TGP Winter 2019/2020 (Zone 6 Only)



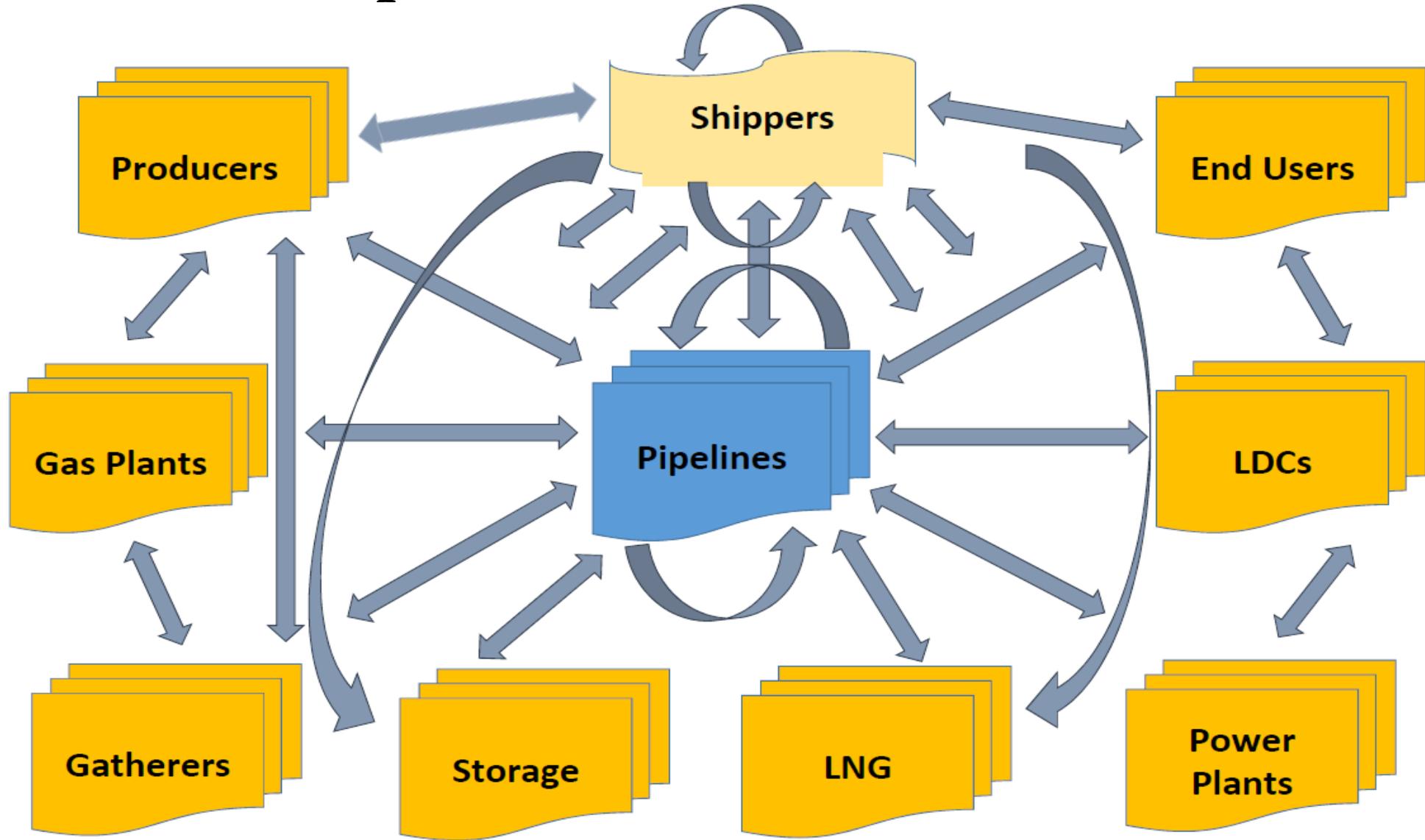
Correlation between Degree Days and OFOs - TGP Winter 2020/2021 (Zone 6 Only)



Scheduling Terms

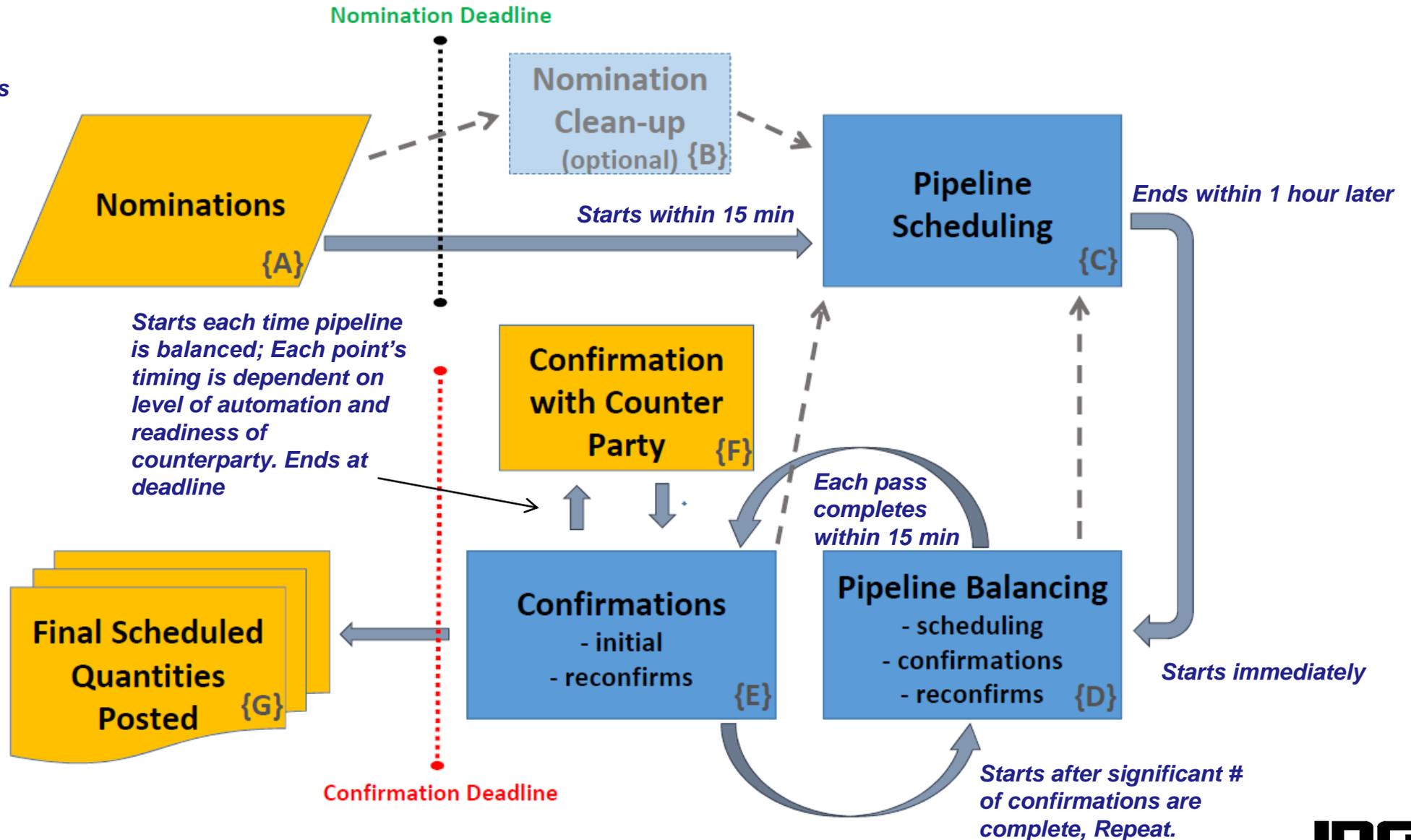
- **Nomination** -- a shipper requests a pipeline to transport gas under a transportation contract from a specified receipt point to a specified delivery point on the pipeline or to make injections or withdrawals under a storage contract
- **Confirmation** -- establishes agreement between two point operators at a location (upstream party to downstream party) to the quantity of gas that will flow to such location. One party is the operator controlling flow at the location.
- **Scheduling** – pipeline compares nominated or confirmed quantities with its available capacity to determine which quantities will be able to flow throughout the pipeline system and/or points of interconnect. This includes any automated or manual procedures to allocate system capacity. Scheduling may occur prior to or after confirmation or multiple times during the evaluation window as determined by the pipeline.

Complex Concurrent Coordination



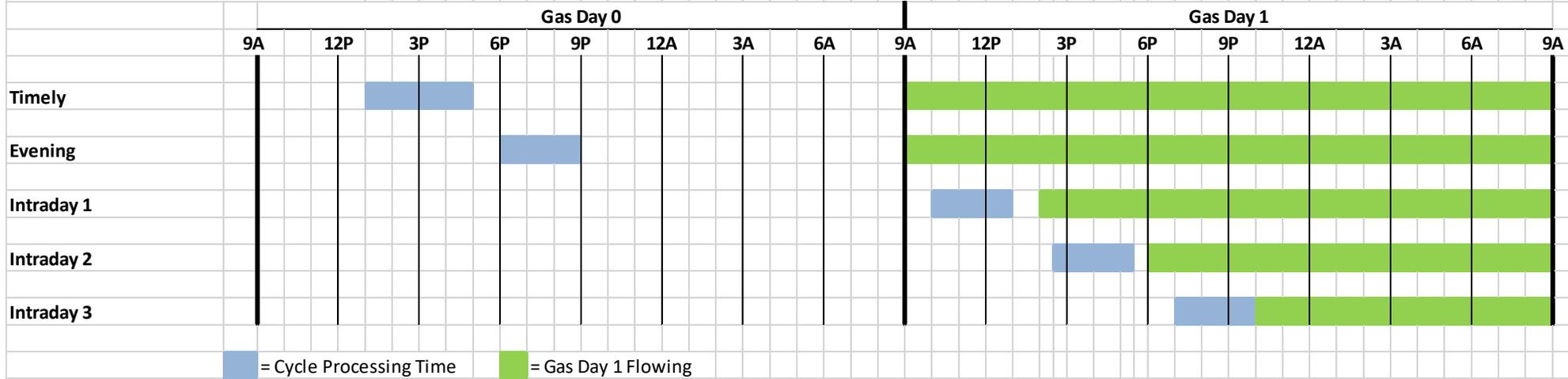
Pipeline Scheduling and Confirmation Process

Times are approximate and depend on size of pipeline, its operating conditions, and readiness of counterparties to confirm



Current Nominations Timeline

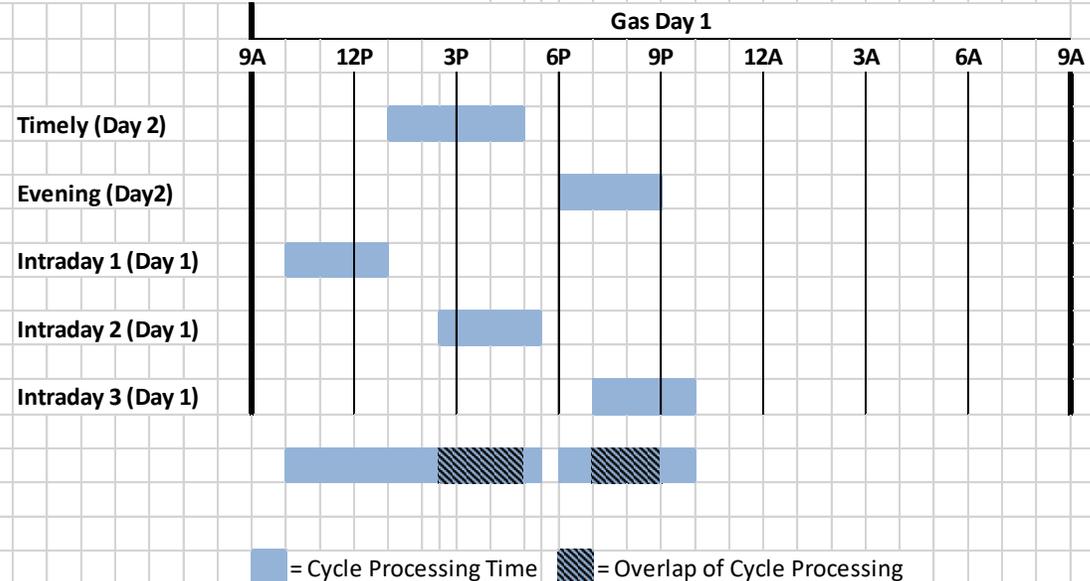
Gas Day 1 Scheduling Timelines



New Timelines (CCT) - eff 4/1/2016

	Nom	Conf	Sched Q	Gas Flow	Bump
Timely (Day Ahead)	1:00 PM	4:30 PM	5:00 PM	9:00 AM	N/A
Evening (Day Ahead)	6:00 PM	8:30 PM	9:00 PM	9:00 AM	YES
Intraday 1 (Current Day)	10:00 AM	12:30 PM	1:00 PM	2:00 PM	YES
Intraday 2 (Current Day)	2:30 PM	5:00 PM	5:30 PM	6:00 PM	YES
Intraday 3 (Current Day)	7:00 PM	9:30 PM	10:00 PM	10:00 PM	NO

Gas Day 1 Scheduling Work Overlaps



Q&A

■ Questions?