2025 NGA Gas Operations School

LNG Peak Shaving Plants - Life Extensions

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Safety Moment

- As hotter temps approach, a quick reminder on hydration:
  - Hydrate before you start work/activities
  - Hydrate before you feel thirsty
  - It may take several hours after finishing work/activity to replace water

Heat Category	WBGT Index, F°	Easy Work		Moderate Work		Hard Work	
		Work/Rest (min)	*Water Intake (qt/hr)*	*Work/Rest (min)*	*Water Intake (qt/hr)*	*Work/Rest (min)*	*Water Intake (qt/hr)*
1	78° - 81.9°	NL	½	NL	¾	40/20 min	¾
2 (green)	82° - 84.9°	NL	½	50/10 min	¾	30/30 min	1
3 (yellow)	85° - 87.9°	NL	¾	40/20 min	¾	30/30 min	1
4 (red)	88° - 89.9°	NL	¾	30/30 min	¾	20/40 min	1
5 (black)	> 90°	50/10 min	1	20/40 min	1	10/50 min	1

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energy infrastructure development

engineering & design | survey & mapping | row acquisition | project management

SURVEY & MAPPING

- GPS Control Networks
- Digital Orthophotography Generation
- Traverse & Detail Surveys
- Property Line Surveys
- Quad/Aerial Photo Based Overview Maps
- Alignment Sheet Generation
- Site Specific Drawing Generation

FEASIBILITY STUDIES

- Land and Utility Research
- Field Investigations
- Environmental Database Searches
- Conceptual Base Plan Development
- Engineering/Environmental Permit Requirement Identification

RIGHT-OF-WAY

- Lands / Title Research
- Access Permissions
- Easement / Fee Negotiations
- Plat Production
- Stakeholder Outreach
- Damage Evaluation & Settlement

PERMITTING

- Federal DOT, State and Local Highway & Railroads
- Local Building Permits
- Zoning Variances
- Stormwater and Erosion Control Plans

ENERGY FACILITIES DESIGN

- Meter & Regulation Stations
- LNG / CNG Facilities
- Compressors
- Material Specifications & Procurement
- Power Plant Fuel Gas Boost Compressors
- LNG Pumping, Vaporization & Boiloff Compression

PIPELINE ALIGNMENT

- Engineering Route Analysis
- Workspace Configurations
- Access Road Analysis
- Contractor/Pipeyard Analysis

PIPELINE DESIGN

- Directional Drills
- Road & Railroad Crossings
- Cathodic Protection
- Mainline Valves, Launcher/Receivers

PUBLIC RELATIONS & PROPERTY RIGHTS

- FERC – Public Scoping Hearings
- State & Local Outreach Programs
- Property Easement Procurement
- Construction Damages Evaluation & Settlements

CONSTRUCTION SERVICES

- Construction Bid Package Preparation
- Construction Bid Evaluation
- Shop & Field Inspection
- As-Built Facility Drawings
- As-Built Pipeline Mapping

Agenda

- Quick Poll
- LNG Background Info
- Why?
- What?
- How?

LNG Peak Shaving Plants – Life Extensions

A quick review of LNG

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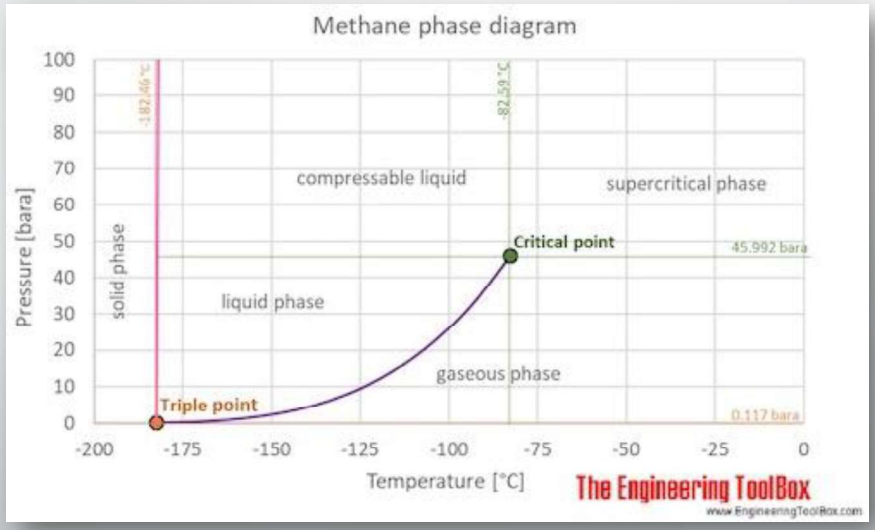
Some LNG Fun Facts Quiz

- Question 1: What temperature does gas turn into liquid?
  - Answer: -260F
- Question 2: Is LNG heavier or lighter than water?
  - Answer: Lighter, density approx. 40% of water
- Question 3: How much does LNG expand when it is turned back into vapor? i.e. how much does 1 cubic foot of LNG equal in gas?
  - Answer: 600 to 1
- Question 4: What country is the largest exporter of LNG (as of 2025)
  - Answer: The United States (13 Billion CF per day)

LNG – A Quick Review

- Liquefied Natural Gas (LNG) is regular pipeline gas that has been cleaned up and cooled (and sometimes until it turns into a liquid. This happens at about -260 degrees F.



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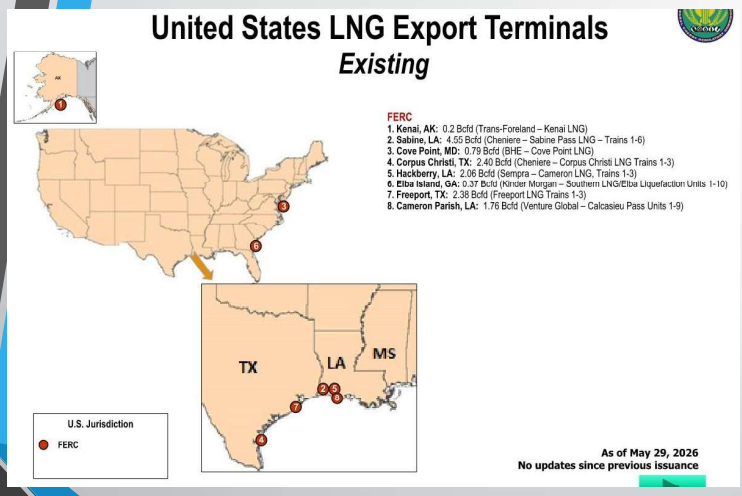
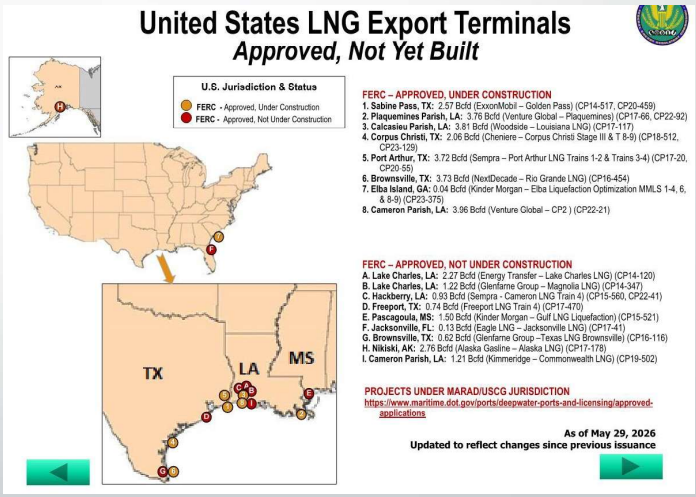
LNG – A Quick Review

- Changing state from gas to liquid occupies significantly less space. In general, the ratio is 600:1
- This factor lends itself well to transport and storage

LNG – Exports

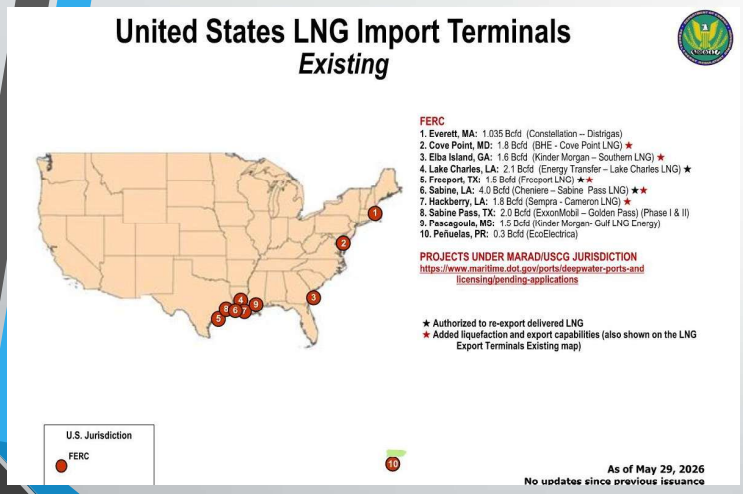
- The other primary use of LNG is to enable shipping of the gas overseas to countries where pipeline gas is not available or not plentiful enough

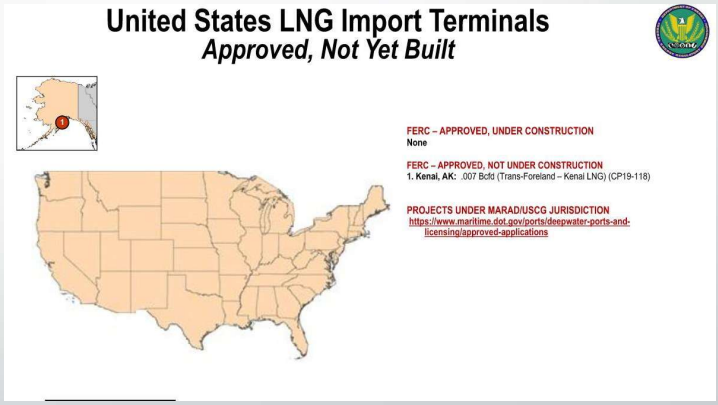




LNG – Imports

- In some areas of the country and during swings in production internationally, the US does import LNG as well. The US hasn't really been a major impoter since 2007.





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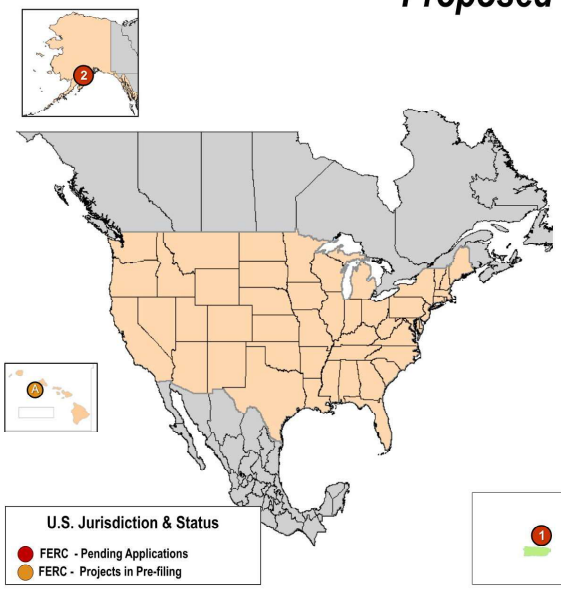
LNG – Imports

United States LNG Import Terminals
Proposed



PROPOSED TO FERC

1. **San Juan, PR:** .217 Bcfd (New Fortress Energy – NFEnergía) (CP21-496)*
2. **Kenai, AK:** .055 Bcfd (Trans-Foreland – Kenai LNG) (CP26-61)

Projects in Pre-filing:

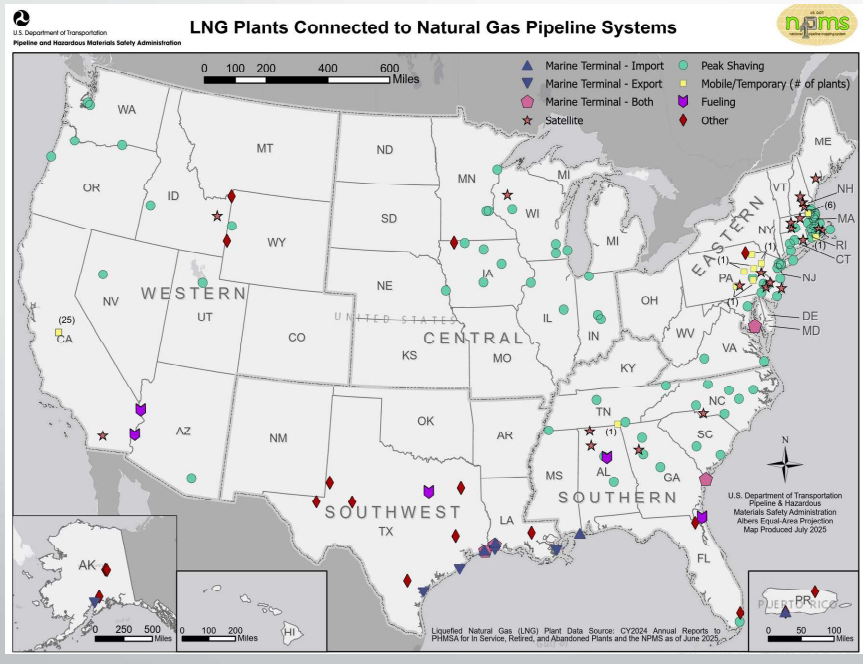
A. **Kalaeloa, HI:** 0.14 Bcfd - JERA Americas – Longboard LNG (PF26-10)

PROJECTS UNDER MARAD/USCG JURISDICTION
https://www.maritime.dot.gov/ports/deepwater-ports-and-licensing/pending-applications

* Already in operation but undergoing additional FERC review per Commission Order on Show Cause under CP20-466.

LNG – A Quick Review

- LNG is often stored in the market areas, usually near the LDC system center, to provide "peak shaving" in the winter.
- Most of this presentation will focus on these peak shavers



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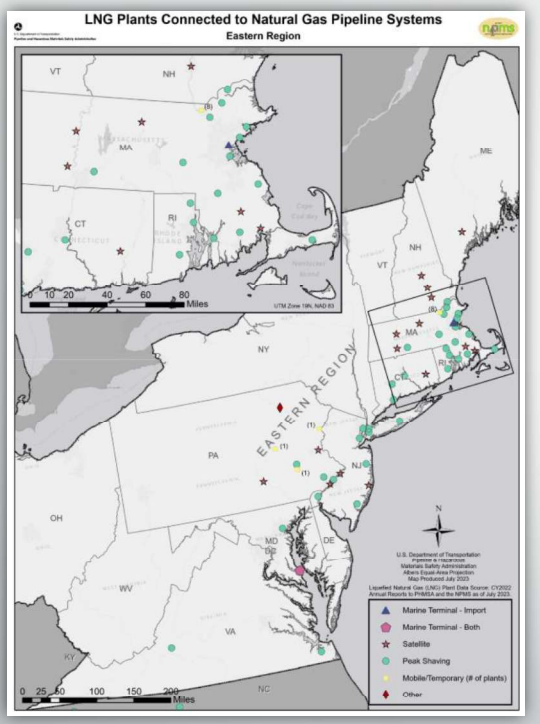
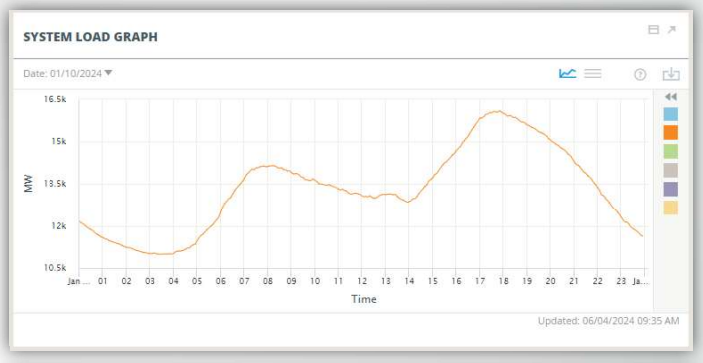
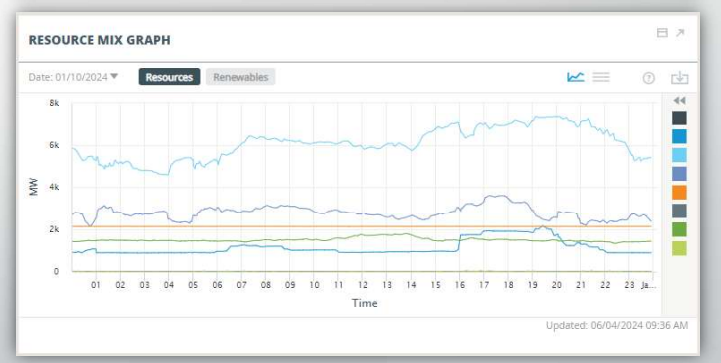
LNG Peak Shaving Statistics

- There are approximately 115 LNG peak shaving plants in the US.
- Over 50 of those are in the Northeast
- Massachusetts alone has 21

LNG Peak Shaving Statistics







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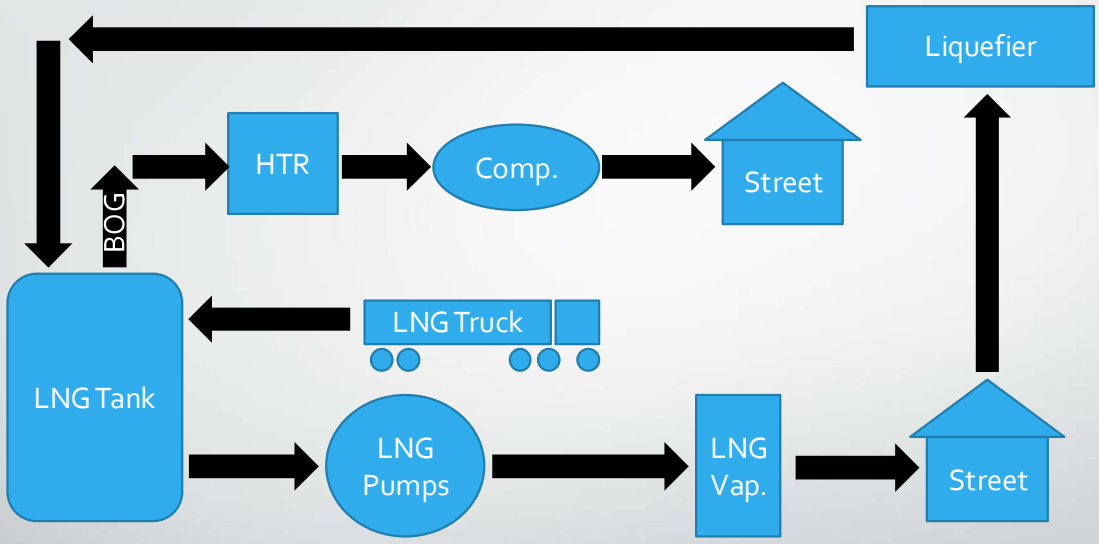
Follow the LNG- Basic System Flow



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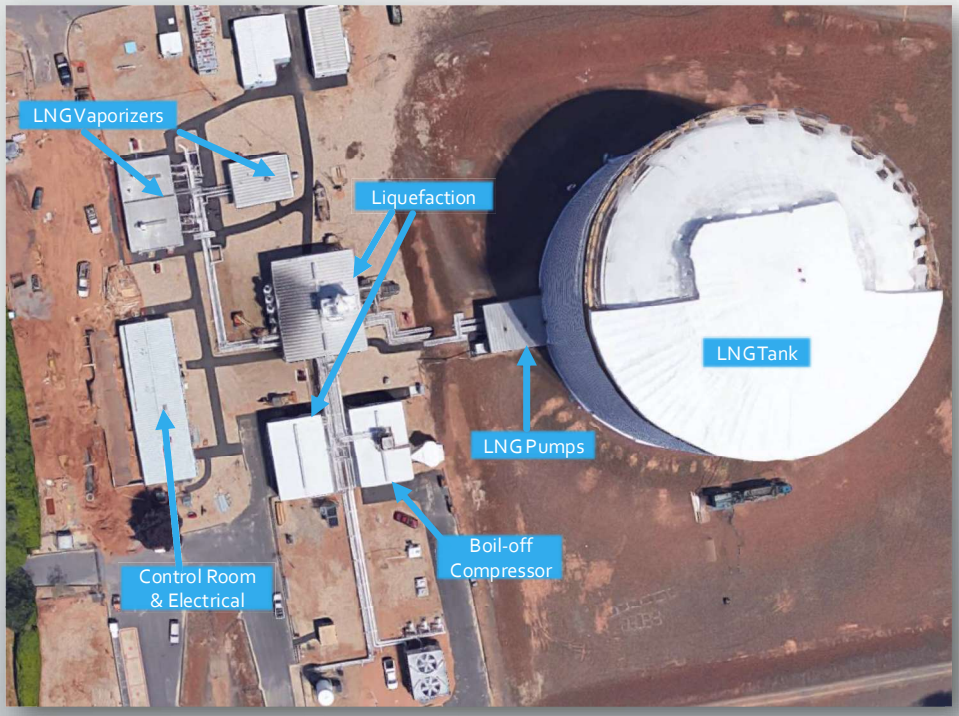
Typical LNG Peak Shaving Plant



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LNG Peak Shaving Plants – Life Extensions

Some info about LNG plants (The Why?)

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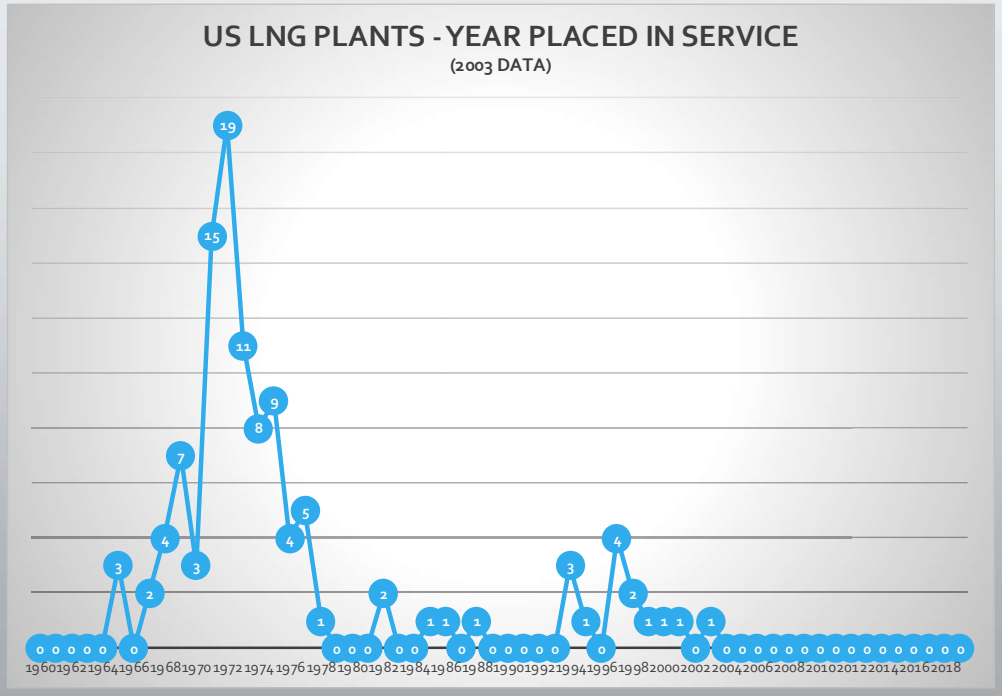
This is Getting Old



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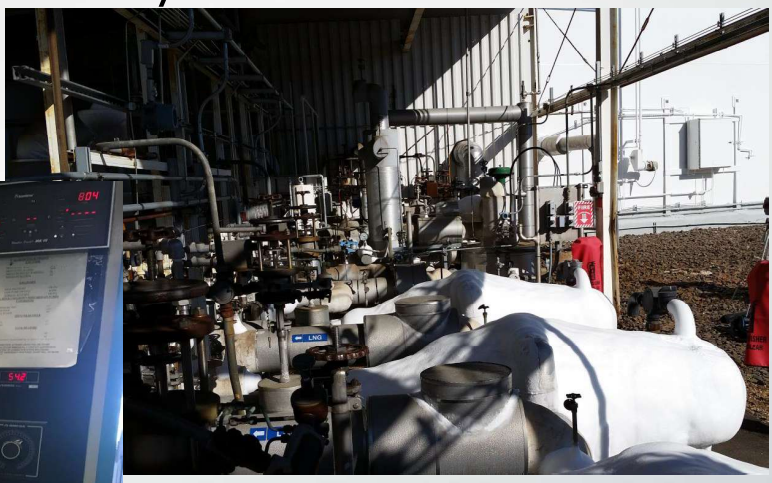
What is End of Life for your LNG Plant?

- The design life of most LNG plant equipment is 40 or 50 years.
- The actual life of components varies. Direct fired vaporizers often do not last 40 years. LNG tanks almost always last more than 50 years.
- Control system components last 10 to 30 years, but then replacement parts cannot be found.
- Most "moving parts" such as pumps, control valves, compressors last about 40 years, just like they were designed to last.
- Electric switchgear also lasts 40-50 years before reliability drops.

What is End of Life for your LNG Plant?



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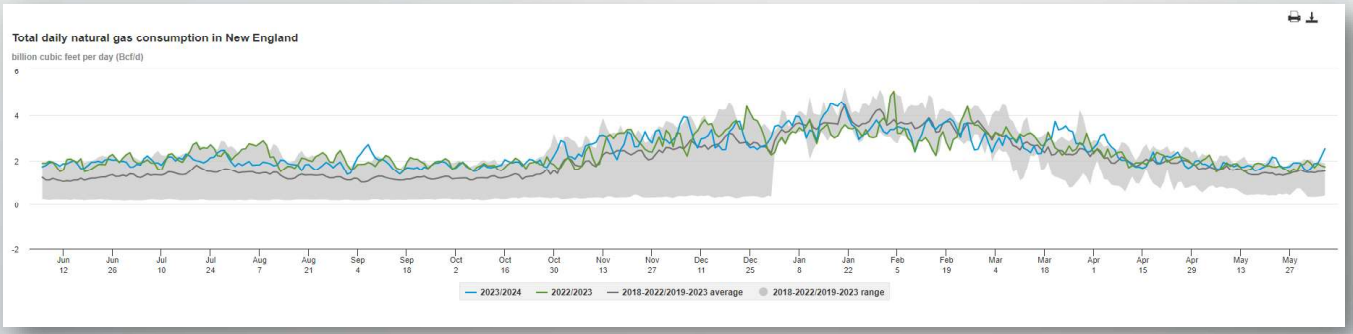
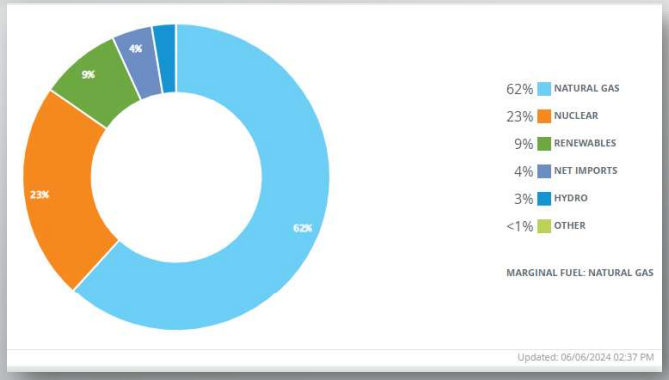
What is End of Life for Your LNG Tank?

- Nobody knows.
- Many peak shaving tanks were built in 1972-74, and all but a few have had no problems.
- At least 5 US peak shavers were built in 1965-67. No problems after 56 years.

The Why





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LNG Peak Shaving Plants – Life Extensions

Components of a life extension (The What?)

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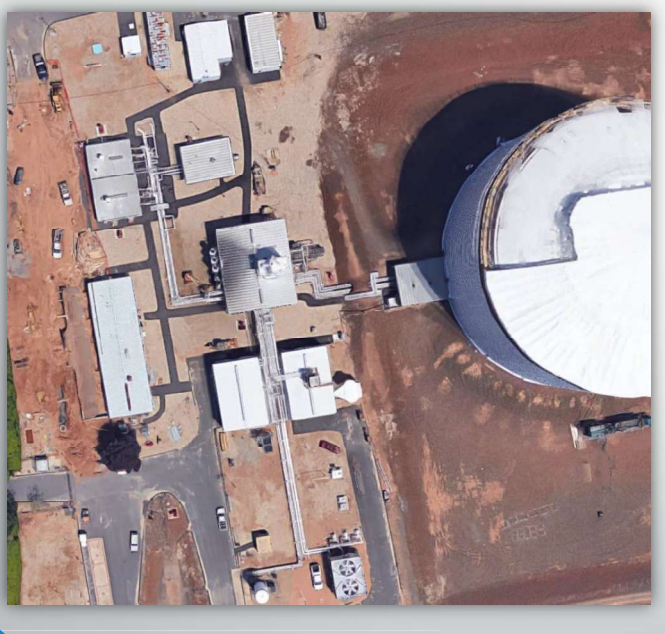
Goals of LNG Plant Life Extension

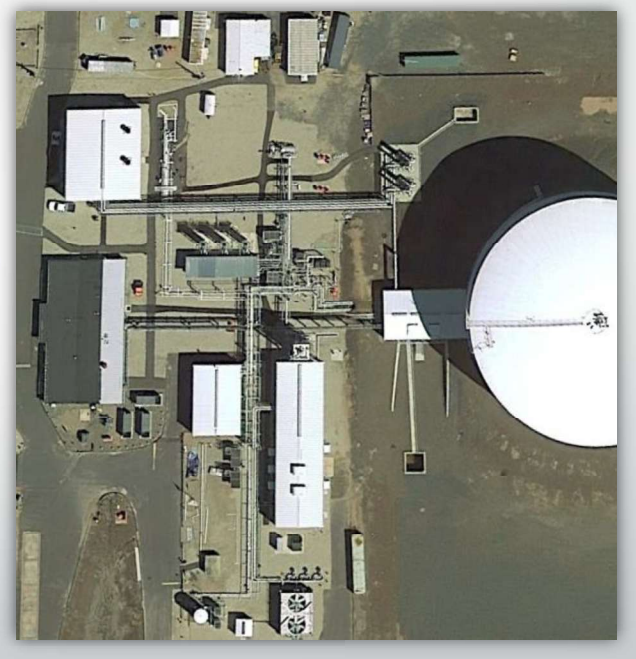
- 25 more years of service.
- Increased safety, both for the public and for the operators
- Potential increased capacity (depending on the plant and the design)
- Added redundancy (a backup for everything)
- Reliability
- Added automation.

What Does a Life Extension Project Include?

- Depends on your plant.
- Could range from a controls upgrade, all the way to "everything but the tank".
- Larger plants will phase the replacements over several years.
- Most Operators specify the life extension to provide 25 more years of service from the plant.
- Note, many tanks will be 70 years old after 25 more years of service.

Before & After a Plant Life Extension





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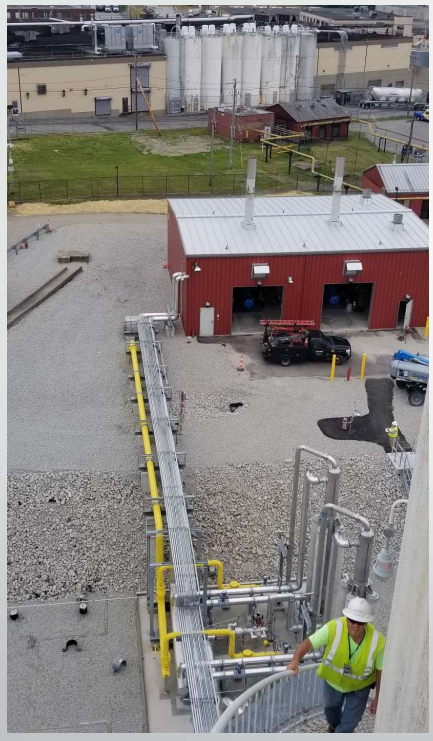


What About Siting?

- This is a long story.
- Most peak shaving plants were built before 1980, when Part 193 (Federal LNG Regulations) was first published.
- These plants are located in populated, sometimes congested areas where they would not be permitted today.
- But, they still need life extension work, and the new stuff needs to meet today's rules, even if the tank would never meet today's rules.

Thermal Radiation and Vapor Dispersion

- Many people have heard of these, but it is a full time job to keep up with the subject
- The rules have evolved in the last 10 years
- PHMSA (the authors of Part 193) have an "FAQ" on their website to help people "interpret" Part 193
- The FAQ suggests rules that are far more strict that those printed in Part 193
- Your State regulator generally has the final say on what you can build

Classic LNG Life Extension Siting Issue

Plant has a tank, and several submerged combustion vaporizers 200 feet away from the tank, outside containment

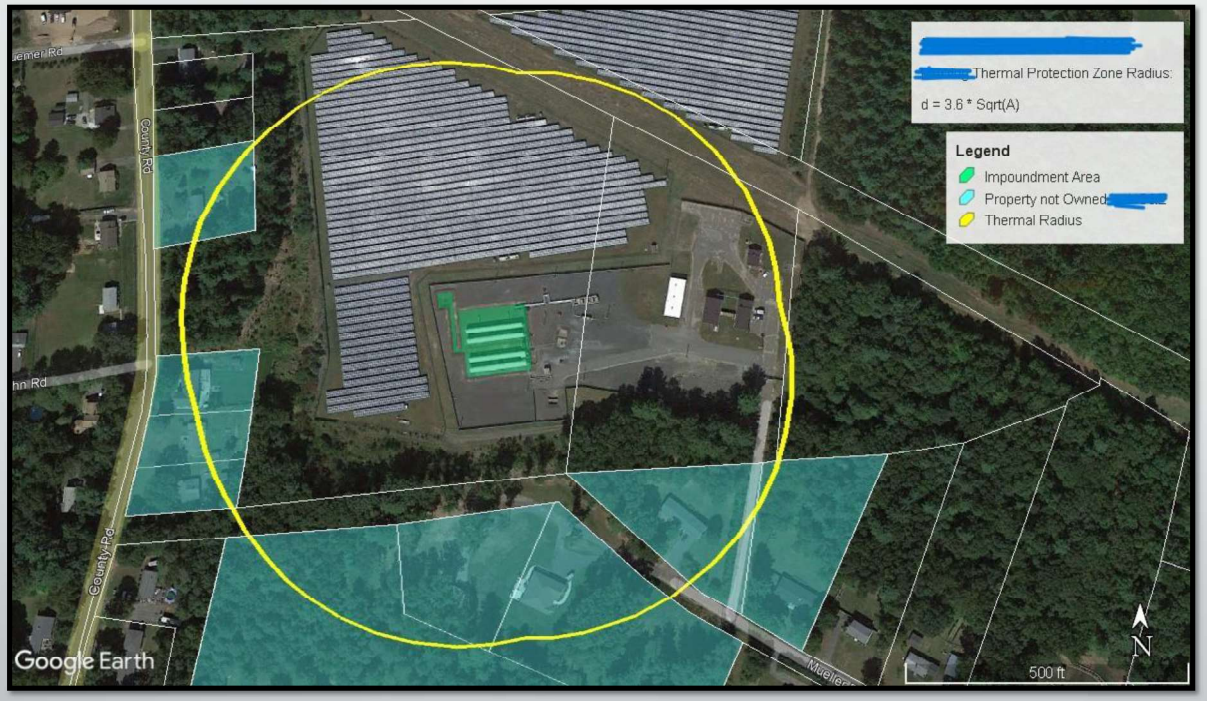
The controls on the vaporizers are obsolete, the coils have been repaired several times, they are at the end of their life

The operator develops a plan to replace the old vaporizers with a new shell-and-tube system, and place the vaporizers inside the tank containment to increase public safety

The new plan is analyzed using today' siting rules as explained in the FAQ and the project does not comply, too much vapor dispersion extending way off site

So, is it "safer" to keep the old stuff?

An Example



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LNG Peak Shaving Plants – Life Extensions

Challenges (The How?)

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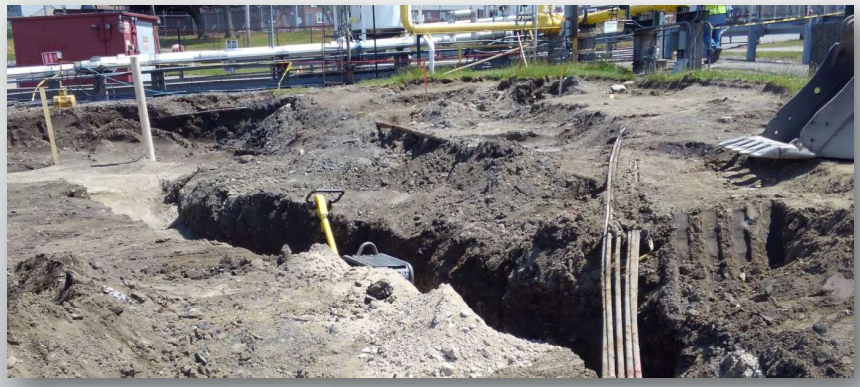
Planning Process-Project Life Cycle

- Needs assessment
- Feasibility Study
- Commercial and Regulatory (internal) approvals
- Conceptual/Preliminary Design
- Long Lead Materials Identification, including the cost
- Permitting
- Detailed Design
- Contracting
- Construction
- Commissioning

Design and Construction Challenges

- Much like in the street, one of the largest challenges faced in construction at a plant is excavation.
- Many LNG plants were built in the same spot as old plants that dealt with all kinds of hazardous materials (tar, coal, propane, steam) in the 1950's before most regulations.
- LNG tanks require an impoundment dike and extremely stable soil, which means moving a lot of dirt.



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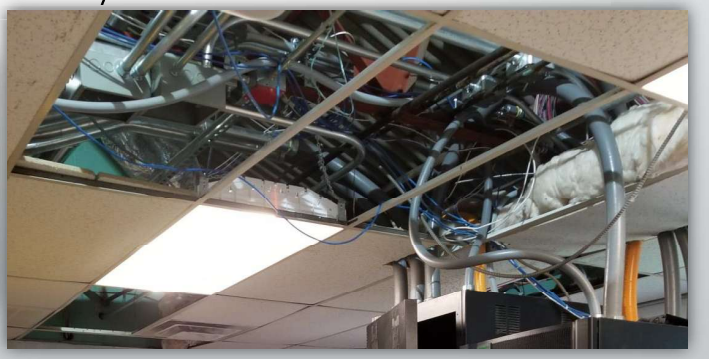
Design and Construction Challenges

- Typically, plants do not have good records of what was installed after the initial drawings were made in the 60's.
- The only resource is typically the operators "Go ask _____, he's been here the longest, he'll probably remember". Many changes were made long before the era of Dig Safe, as-builts and survey.
- Electrical panels and conduits are no exception. A common item found in LNG plant control rooms is a "wire trough" in which decades of wires were just dropped in, creating a spaghetti bin of mixed voltage wires.
- In some cases, major valves could be depicted differently or not at all due to insulation that has never been replaced.



Design and Construction Challenges

- LNG tank foundations are typically "ring" foundations with the middle bottom being sand with a material called foam glass on top. This material is incredibly sensitive and is subject to cracking after years of normal service.
- The process equipment off the tank (pumps, valves, vaporizers, etc. is always in close proximity to the tank, so how do you construct safely this close to the sensitive foundation?
- Sheet and driven piles are a no-go because of vibration, and more often than not you're too close for sloping, as it would undermine the tank or other existing structures.

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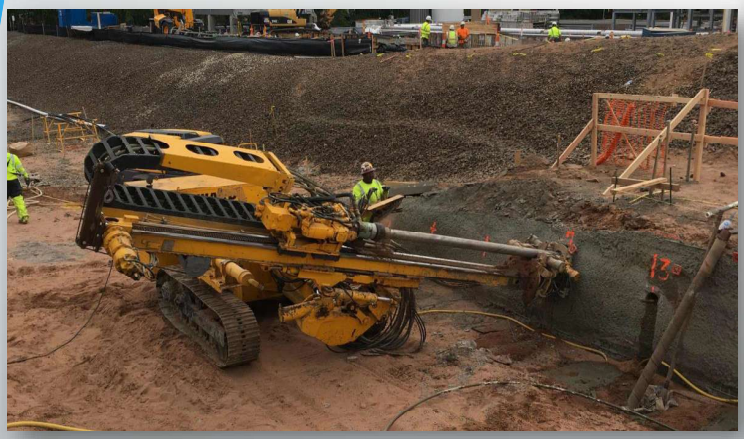
Soil Nails



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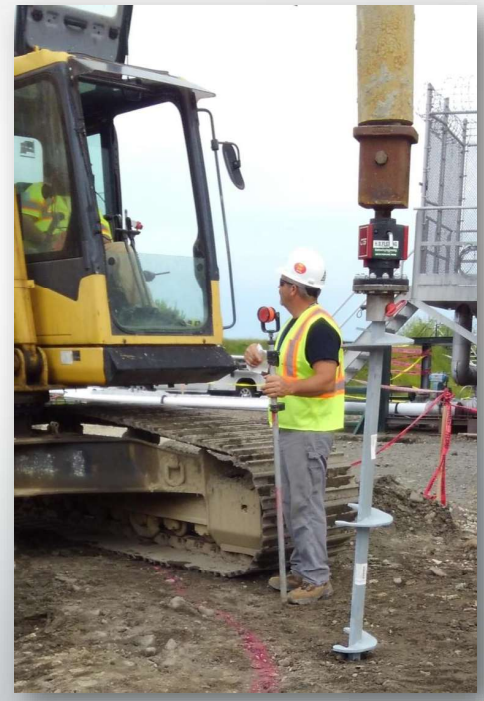
Helical Piles



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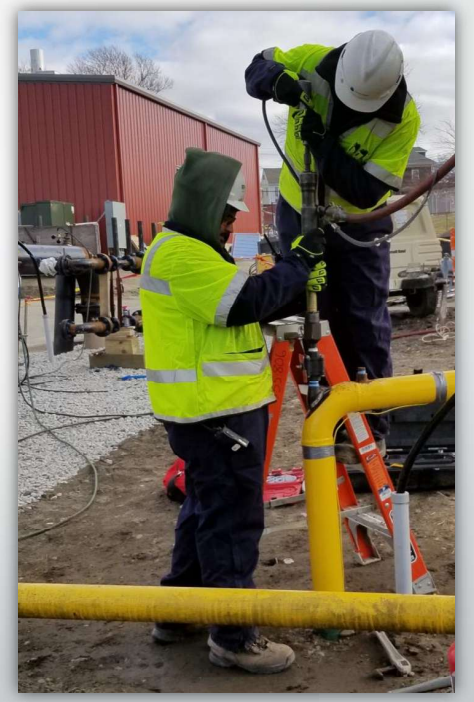
Purging and Tie-in

- With little to no drawings of existing facilities, purging and tie-ins requires many days of pre-planning and field work. Some of these systems have never been gassed-out in their 40 years of service.
- On the tank each connection is typically a single valve that holds back either liquid or gas, which after 40 years of service cannot be repaired or replaced, and typically does not function properly anymore and leaks.
- Especially on the liquid lines, this makes any tie in a critical activity, with high risks, that requires planning, creativity, and thorough precautions.
- As the service is cryogenic, typical means of stopping flow do not work (valve sealant, plugs, bags).

Outages

- Outages at LNG plants are also critical, both on a project scale and on a system scale.
- Some plants can shut down for a whole season, which allows for demolition, then construction in the same place. Others may be called to use, which means construction in close proximity to the live system . This poses schedule, coordination and hazards. Especially is there is some equipment that is to be re-used.
- In plants some systems cannot be shut down for more than short period of time (boil off gas). This means all work has to be prepped and completed, then tied in, NDE'd and commissioned all in a single outage, which can be as short as hours.



Cutovers

- The existing infrastructure inside a 40 year old LNG plant obviously doesn't interact well with modern equipment, pneumatics vs. electric signals, different voltages, equipment that no longer is made.
- The challenge is that some of this equipment can't be replaced (old tank valves) without totally emptying the LNG tank, something that takes many months of planning and costs a lot of money.
- For some items, they cant be replaced until the new version is installed, which means running two electric systems and two controls systems, both very different, side-by-side.

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Training

- Now there is a brand new LNG plant, it does the same thing as the old plant, but in a totally different way than it used to.
- The operations team may have knowledge of the process from a high level, but has been operating the same system the same way for most of their careers and for the whole life of that plant.
- Since the old system is gone, knowledge accrued over years in some cases by teams of people, has to be effectively communicated to a handful of operators. This has to be done to give them a comfort level with a system they've never used, to operate it when the project is over.

Summary

- Your plant is getting old
- You may still need it for quite some time
- You are not alone
- Projects like this take time, money, and effort so start the process early

Questions?