

U.S. Coast Guard Review of Natural Gas Fueled Vessels

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Good afternoon ladies and gentlemen. My name is Tim Meyers, and I work for the Coast Guard's Office of Design and Engineering Standards in Washington, DC. Today I plan on sharing information with you on the Coast Guard's approval process for Natural Gas Fueled Vessels.

Outline

- **Current Interest in U.S. Maritime Industry**
- **Air Emissions Requirements**
- **Existing standards & regulations for gas-fueled ships**
- **The Coast Guard's process for reviewing domestic gas-fueled vessel design**
- **Specific safety considerations in vessel design**
- **Coast Guard regulation of fueling infrastructure**



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First I'd like to mention the current level of interest we are seeing here in the U.S.;

Next I'll go over recent air emissions requirements which are a major driver for vessels considering a switch from traditional marine fuels to natural gas.

Then I'll discuss some of the existing standards out there for gas fueled ships;

I'll walk you through the Coast Guard's design approval process for vessels incorporating gas fueled systems, including recent policy my office has published to streamline the process;

Then I'll highlight some of the specific safety considerations in gas-fueled vessel design;

And finally I'll take a few minutes to discuss Coast Guard regulation of fueling infrastructure.

Recent Interest in the U.S.



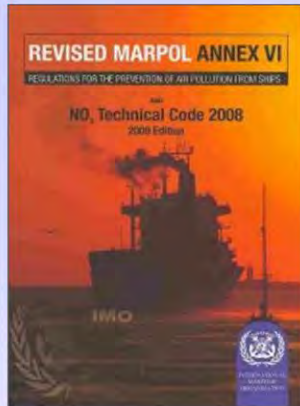
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The Coast Guard has seen quite a bit of interest lately in the use of natural gas as a marine fuel. Over the last two years, we've received numerous inquiries including half a dozen formal concept review requests for vessels fueled by LNG. This interest runs across a broad spectrum of vessel types, including passenger vessels such as the Washington State and Staten Island Ferries, cargo ships such as the container RO/RO ships operated by TOTE out of Seattle, harbor tugs and inland river push-boats, and OSVs like those currently being built for Harvey Gulf.

Air Emissions Requirements



- MARPOL Annex VI
- U.S. implementation:
Act to Prevent Pollution
from Ships (APPS)
 - NO_x
 - SO_x



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One of the major motivations for switching to natural gas fuel is the enactment of recent air emissions requirements. Under Annex VI to the International Convention for the Prevention of Pollution from Ships (MARPOL), progressively more stringent limits for nitrogen oxide (NO_x) and sulfur oxide (SO_x) emissions are being placed on the global shipping industry over the next decade. Within the U.S., these requirements are implemented through the Act to Prevent Pollution from Ships (APPS).

NO_x Standard (g/kW-hr)

NO _x Tier	Area of applicability	Model Year	Maximum in-use engine speed		
			Less than 130 RPM	130-2000 RPM	Over 2000 RPM
Tier 1	All U.S. navigable waters and EEZ	2004-2010	17.0	45.0 * $n^{-0.20}$	9.8
Tier 2	All U.S. navigable waters and EEZ	2011-2015	14.4	44.0 * $n^{-0.23}$	7.7
Tier 2	All U.S. navigable waters and EEZ, excluding ECA and ECA associated areas	2016 and later	14.4	44.0 * $n^{-0.23}$	7.7
Tier 3	ECA and ECA associated areas	2016 and later	3.4	9.0 * $n^{-0.20}$	2.0

n is maximum in-use engine speed, in RPM, rounded to one decimal place

Sulfur Standard in Fuel (max % by weight)

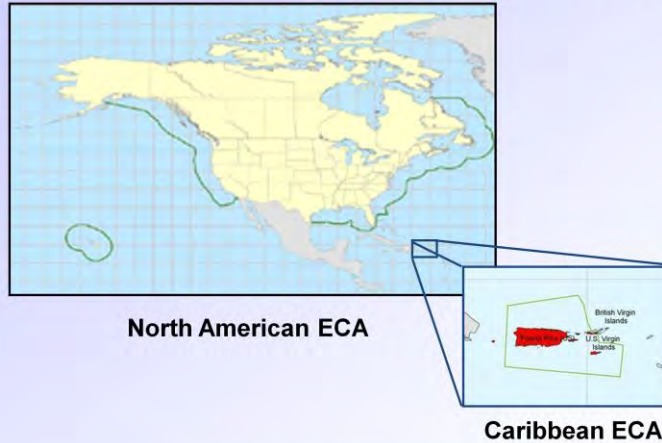
Calendar years	Sulfur limit in all U.S. navigable waters and EEZ	Sulfur limit in ECA and ECA associated areas
2010-2011	4.50%	1.00%
2012-2015	3.50%	1.00%
2016-2019	3.50%	0.10%
2020 and later	0.50%	0.10%



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NO_x emissions limits are being imposed in a tiered approach based on engine speed, and SO_x is being limited primarily by regulating sulfur content in fuel. The most stringent requirements come into play within Emission Control Areas (ECA).

U.S. Environmental Control Areas



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The North American ECAs encompass a 200 nautical mile band around most of North America and the Hawaiian Islands, and roughly 40-50 nautical miles around Puerto Rico and the U.S. Virgin Islands. Once fully in place, vessels operating within these areas will be subject to the most stringent emission requirements.

Using natural gas as fuel is one of the most promising methods for meeting the new emission standards. The conversion from burning diesel to natural gas within internal combustion engines significantly reduces emissions. Some engine manufacturers report reductions as high as 85% for NO_x, and the total elimination of SO_x since natural gas does not contain sulfur. Accordingly, a gas-fueled engine can be compliant with even the strictest air emissions requirements. Therefore, natural gas seems an ideal solution in meeting the increasingly stringent air emissions mandates, especially for those vessels operating within U.S. ECAs.

International GFS Standards



**Interim Guidelines on Safety for
Natural Gas-Fuelled Engine
Installations in Ships**

Class Society Rules & Guides



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Coast Guard regulations don't address the use of natural gas as fuel, except as a means of controlling cargo boil-off on LNG carriers. There are, however, a number of standards out there that we can look to for guidance. The International Maritime Organization (IMO) is developing a code for gas fueled ships, and several of the major classification societies now have rules or guides for vessels that use natural gas as fuel.

IMO Standards

- IMO Resolution MSC 285 (86)
 - “Interim Guidelines on Safety for Natural Gas-fuelled Engine Installations in Ships”
 - Adopted 1 June 2009
- International Gas Fueled Ships Code (IGF Code)
 - Completion expected 2014



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As the lead agency representing the U.S. at IMO, the Coast Guard has taken an active role in efforts to develop a Code for Gas-Fueled Ships. Efforts started in 2005, and in June of 2009 Interim Guidelines were published. IMO's current focus is to harmonize the IGF Code with the latest revision of the IGC Code for gas carriers, and also to extend the code to address low-flashpoint fuels other than natural gas. Completion of the IGF Code is expected in 2014.

U.S. Review of Gas-Fueled Vessels

Coast Guard analysis has been
on a Case-By-Case Basis

- Concepts have used **IMO Interim Guidelines** as a baseline standard
- Additional requirements tailored to each specific review
- Design Basis – framework of standards and requirements



Equivalent level of safety to
Title 46 CFR



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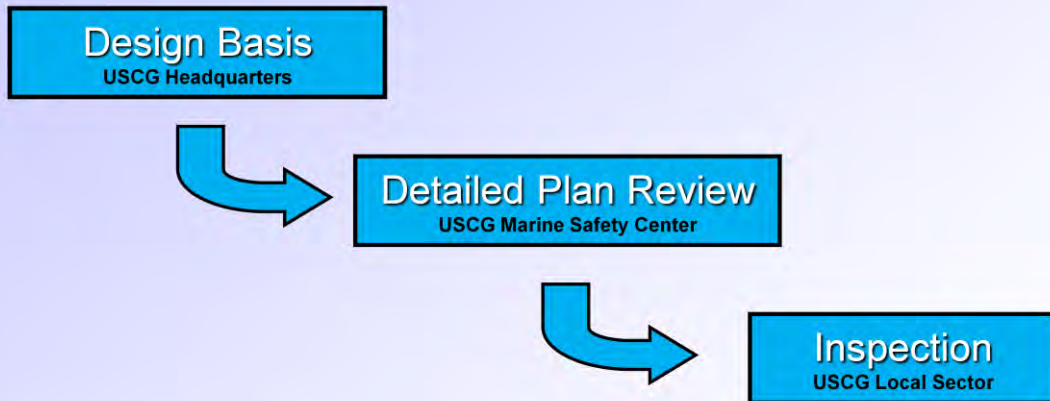
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As I mentioned earlier, my office published a policy letter in April to streamline the review process for gas-fueled vessel designs, but before I cover that, let me explain the process we've been using up to this point.

Since Coast Guard regulations don't address natural gas as a marine fuel, except for on LNG carriers, we've been reviewing proposals for gas-fueled vessels on a case-by-case basis. These proposals go through a concept review by my office at Coast Guard Headquarters to determine whether they will meet an equivalent level of safety to that of vessels with systems using traditional fuels. So far, concepts we have reviewed have used the IMO Interim Guidelines as a baseline standard, and we have added requirements where necessary to ensure a level of safety equivalent to that in the Code of Federal Regulations. Headquarters concept reviews result in the approval of a Design Basis laying out an acceptable framework of standards and requirements for design and further detailed plan review by the Coast Guard.

Approval Process for U.S. Gas-Fueled Ship Designs



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This slide shows the review process...

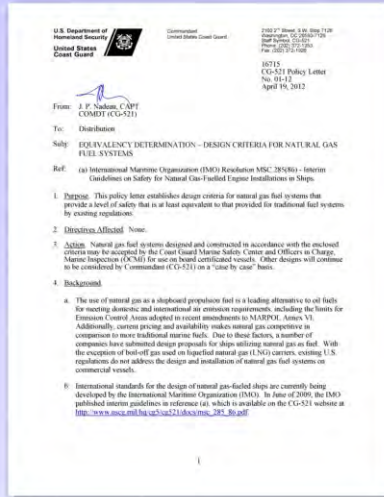
Concept reviews are conducted at Coast Guard Headquarters resulting in an approved Design Basis;

As plans are developed and submitted, the Coast Guard's Marine Safety Center conducts plan review against the standards and requirements listed in the approved Design Basis;

During vessel construction, marine inspectors from the local Coast Guard Sector ensure that a vessel is being built according to plans approved by the Marine Safety Center.

U.S. Review of Gas-Fueled Vessels

New Policy Letter 01-12



- streamlined review process
- provides “equivalent level of safety” to **46 CFR**
 - no CG Headquarters concept review
 - can go straight to MSC for plan review
- baseline is **IMO Interim Guidelines**
- designs outside policy can still apply for Concept Review



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In an effort to streamline this process, and provide up-front design criteria that the Coast Guard will accept, our office recently published Policy Letter 01-12. This policy letter provides one avenue for determining an equivalent level of safety to the CFRs. If your design meets the criteria in the policy, you can skip the Headquarters concept review, and go straight to the Marine Safety Center for plan review.

The policy uses the IMO Interim Guidelines as a baseline standard, and provides additional requirements to ensure an equivalent level of safety.

The policy letter lays out one set of design criteria for demonstrating equivalency, and is very prescriptive in some areas. We recognize, however, that there may be other means of achieving equivalency. If your design falls outside the limits of this policy, you can still bring your proposal to Headquarters for concept review and a Design Basis approval on a case-by-case basis.

Approval Process for U.S. Gas-Fueled Ship Designs



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Here is the process under our new policy...

Safety Considerations

- **Fuel System**
 - Machinery space configuration
 - Tank placement
 - Tank & piping requirements
- **Gas Detection**
 - System certification
- **Hazardous Locations**
 - Classification of areas
 - Electrical equipment
- **Fire Protection**
 - Installed firefighting systems
 - Fire detection



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Since we're using the IMO Interim Guidelines as a baseline standard, the policy is structured as a "supplement" to the guidelines, and provides additional requirements or modifications to the guidelines in areas of particular concern. Some of the major areas the policy addresses are listed here, including:

Fuel system configuration within the machinery space

Tank placement

Tank & piping requirements

Gas detection system certification

Classification of hazardous areas and electrical equipment

And, Details for fire protection systems

While there isn't time to cover all the specifics, I'd like to highlight at least one example to give you an idea of the kind of requirements listed in the policy. I should have time at the end of the presentation if anyone has specific questions about any of these areas, and I'll also be available after this session for one-on-one discussions.

Electrical Equipment in Hazardous Locations

- Equipment selection
 - certified to **NEC** or **IEC** based standards
 - certified by an independent laboratory recognized by USCG under **46 CFR 159.010**
 - **ATEX** certification does not indicate compliance with USCG requirements



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A good example of how the policy modifies the IMO Interim Guidelines is in the selection of electrical equipment for hazardous locations.

Chapter 4 of the guidelines states that the type and installation of electrical equipment for hazardous areas should be in accordance with a recognized standard, and it points to the International Electrotechnical Commission Code (IEC) as an acceptable standard.

Policy Letter 01-12 provides more detailed guidance which is in line with the Coast Guard's domestic Hazardous Area requirements in 46 CFR Subchapter J.

It requires certification to either the National Electric Code, or the IEC. And it lists out the acceptable UL, FM, CSA, ISA or IEC equipment standards under each scheme.

It requires the equipment to be certified by an independent laboratory recognized by the Coast Guard under Part 159 of 46 CFR.

It also points out that the Coast Guard doesn't recognize ATEX certifications as proof of meeting Coast Guard requirements.

Policy Letter 01-12 – Limitations

Policy does not address the following:

- fuel stored as compressed natural gas (CNG)
- single-wall gas piping in engine room (ESD-concept)
- fuel tanks below accommodation spaces
- Portable fuel tanks, or “tank-tainers”

Limited Scope:

- vessel & system design, not operational requirements



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Technology is still evolving, and the Coast Guard is continuing to learn more as new designs are developed. To strike a balance between giving industry clear acceptable design criteria, and ensuring safety as we learn more about these new technologies, there are some limits built into the policy’s design criteria.

The policy only addresses natural gas stored as LNG. Designs using compressed natural gas (CNG) should go to CGHQ for concept review;

Designs with tanks below accommodation spaces will need to be reviewed at Headquarters;

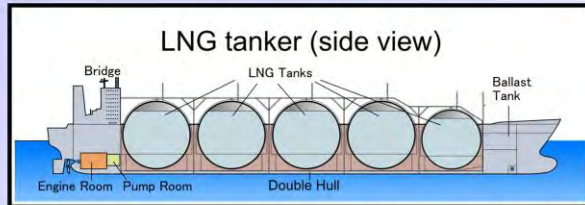
Systems that use the ESD-concept, with single-wall gas piping in the engine room, will also need Headquarters review;

And novel applications not covered by the IMO’s Interim Guidelines, such as the use of portable fuel tanks, also need a concept review at Headquarters.

Also, the new policy only deals with the design of the vessel and its systems. It doesn’t address operational issues such as requirements for bunkering, or crew training & certification. Those areas will be covered separately by other Coast Guard Headquarters offices, and local Sector Commands.

This policy is not the Coast Guard’s “final answer”. As technology continues to develop and we learn more, we’ll update the policy. We also welcome industry’s input to help us come up with reasonable and realistic criteria to address the risks associated with natural gas fuel. A good example is in the configuration and placement of fuel tanks...

Tank Placement



clear separation on gas carrier



not so easy on gas-fueled ship



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There is ongoing debate among IMO members developing the IGC Code on the placement of fuel tanks below accommodation spaces. The current IMO guidelines don't prohibit this, but it goes against the longstanding practice on gas carriers of providing clear separation between LNG storage tanks in the cargo block, and other areas not related to cargo ops.

This is easy to do on a tankship, but other ship types may not allow for such a well-defined area to be dedicated exclusively to storage and transfer of natural gas fuel.

Tank placement relative to other areas on a gas-fueled ship will require considerable thought. The various risks to the tank and their consequences must be weighed; and careful consideration given to the measures in place to prevent or mitigate these consequences.

References

Both available on CG-521 Website:

- Policy Letter 01-12
- IMO Interim Guidelines

www.uscg.mil/hq/cg5/cg521



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Links to the Policy Letter and the IMO Interim Guidelines are available for download on our webpage.

Regulation of Fueling Infrastructure



(Illustration by I.M. Skaugen)



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Before I finish, one point I'd like to touch on that falls outside vessel design standards is the Coast Guard's involvement with refueling or bunkering operations, including regulation of the fueling infrastructure. Since bunkering of LNG as fuel is new in the U.S., there is a lot of uncertainty within industry on how it will be regulated.

There are basically three different methods envisioned for supplying fuel to LNG-powered vessels. These include:

- Using a fixed shore-side fueling terminal
- refueling by tank-truck
- or refueling by bunker barge or bunker vessel

The Coast Guard has regulations in place under 33 CFR to address the transfer of LNG at shoreside terminals as well as regulations that cover bunkering of traditional liquid fuels by all the methods I just mentioned. However there are some gaps in the applicability of these requirements to transfers of LNG as fuel. Also, existing LNG facility and transfer requirements were developed with large-scale cargo terminals in mind, not the smaller-scale fueling facilities we expect to see supporting LNG fueled vessels. Coast Guard Headquarters is actively working on policy to address these gaps and provide clear guidance on how existing regulations will apply to LNG fuel transfers.

Since port-specific considerations often come into play, final decisions with regard to facility requirements and bunkering operations are made by the local Coast Guard Captain of the Port. Therefore anyone considering a vessel or facility project involving LNG fuel should start discussions early on with the Coast Guard Sector office that has jurisdiction in the area they will be operating.

Conclusions

- ✓ new Policy Letter 01-12 for streamlined review
- ✓ case-by-case review if outside policy scope
- ✓ IMO Interim Guidelines as baseline standard
- ✓ Bunkering addressed by local Captain of the Port
- ✓ start discussions with Coast Guard early!



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Here are just a few parting thoughts in summary:

Policy Letter 01-12 was developed to streamline the vessel review process, and provide up-front design criteria to industry;

If your design doesn't follow the policy letter's criteria you can still go to Coast Guard Headquarters for a case-by-case Concept Review;

We consider the IMO's Interim Guidelines as a baseline standard under both the new policy, and case-by-case reviews;

Bunkering issues and refueling infrastructure requirements will be decided by the local Coast Guard Captain of the Port.

To help avoid unnecessary delays, we highly encourage designers and ship-owners to start discussions with Coast Guard early in the design process.

Thank You

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Thank you for your attention. I'd be happy to answer any questions you may have.