Roadmap to SOLAS

PaXell WP5 result

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e4ships Brennstoffzellen im maritimen Einsatz
Ein Projekt im Nationalen Innovationsprogramm Wasserstoff- und Brennstoffzellentechnologie
nip Nationales Innovationsprogramm Wasserstoff- und Brennstoffzellentechnologie
funded by: Federal Ministry of Transport and Digital Infrastructure
coordinated by: NOW National Organisation Hydrogen and Fuel Cell Technology

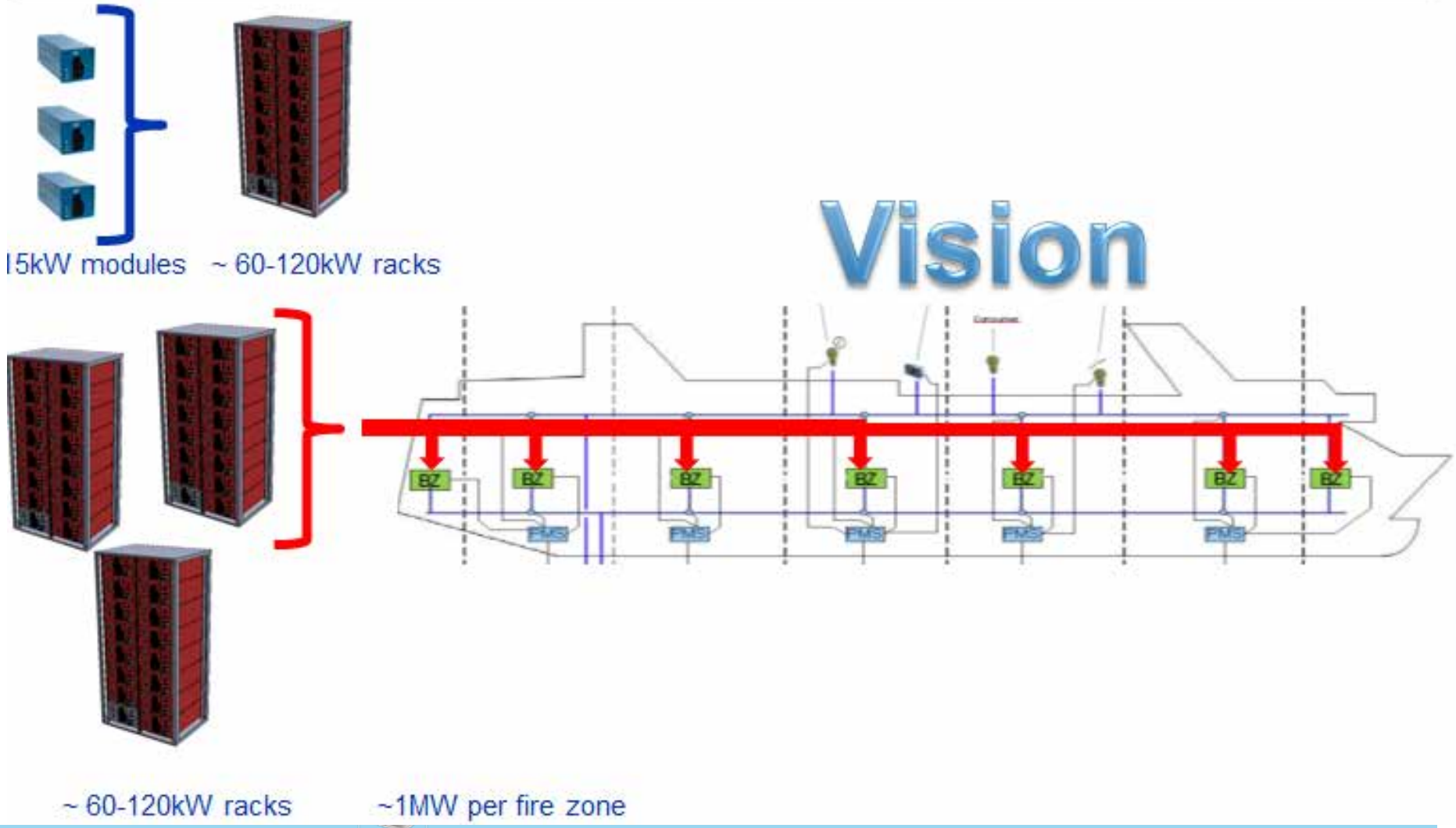
Target

- Increased safety through …
  - enhanced redundancy and
  - reduced energy density

- … by distributed supply of
  - fuel for energy converters
  - thermal energy
  - electric power

- Phased approach
  - PaXell phase I: one fuelcell installation in engine room
  - *PaXell phase II: multiple fuelcells in one fire zone*
  - *PaXell phase III: multiple fuelcells in multiple fire zones*
  - *PaXell phase IV: fuelcells for emergency energy generation*

Phased approach



Showstopper

- Phase III
  - SOLAS requirements for Central electrical power generation and Main Switch Board
- Phase IV
  - SOLAS requirements for Emergency generator
    - not used for other purpose
    - prescription of high flash-point fuel (> 42 deg C)

Means to overcome an obstacle in SOLAS

- Principle of equivalency
- Based on risk analysis
- Details are outlined in SOLAS II-1, reg. 55, and MSC / Circ. 1023 and MSC/Circ. 1212
  - Comprehensive risk analysis, published (made available to all flags)
  - Defined, cross-professional group for the HAZID
  - Active contribution from at least one Flag

Roadmap –PaXell and beyond (1/6)

Activity	Part	Name	Scope	Means
1		**Basic Technology Demo**	Develop and demonstrate unit suited for use in DiPoGen arrangement	PaXell Phase I 2010 - **2015**
2		**Large Scale Technology Demo**	Develop and demonstrate energy generation for hotel loads in **one complete fire zone** (FZ Energy Module)	PaXell Phase II 2015 – **2018**(?)
3.		**Risk analysis**	Perform necessary risk analyses to facilitate deviation from SOLAS rules	In parallel with PaXell Phase II. Need data from PaXell Phase II as input before completion
4		**Full scale Distributed Power arrangement**	Develop and demonstrate use of distributed fuel cell arrangement as a ships auxiliary energy system	2018 – **2024** (?)
5		**Optimized stand-alone DiPoGen**	Develop arrangement for optimized safety and redundancy by distributed energy generation system for auxiliary load without conventional power supply as back-up	Risk Analysis as per SOLAS II-1, reg. 55, MSC/Circ. 1023 and MSC circ.1212

Roadmap – PaXell and beyond (2/6)

Activity	Part	Name	Scope	Means
1		Basic Technology Demo	Develop and demonstrate unit suited for use in DiPoGen arrangement	PaXell Phase I 2010 - 2015
	1.1	Develop FC module and rack	Develop, test, FMEA to class rules, FAT for class and yard of Module and rack	In progress dec.2012
	1.2	Plan fuel supply system	Develop approved plan for providing methanol fuel to FC location in (or near) engine room	Discussed, principles agreed 2010
	1.3	Electrical connection	Develop approved plan for connecting FC rack to ship's MSB (prepare for later connection to de-central fire zone switchboard)	Note: "Surplus energy source", DNV, 2010
	1.4	On-board demonstration	Install FC as per 1.1 – 1.3, test it for 10 000 hours of operation, demonstrate replacement of module	2015 – End of PaXell Phase I
	1.5	Codes and regulations	Identify rules / codes that must be deviated from in order to build DiPoGen	PaXell November 2012
	1.6	Roadmap	Develop plan for how to realize DiPoGen	PaXell December 2012
	1.7	Presentation to Flag	Present plan for DiPoGen for IMO delegates	PaXell Q2 2013

Roadmap – PaXell and beyond (3/6)

Activity	Part	Name	Scope	Means
2		Large Scale Technology Demo	Develop and demonstrate energy generation for hotel loads in one complete fire zone (FZ Energy Module)	PaXell Phase 2 2015 – 2018(?)
	2.1	Local fuel storage	Develop approved plans for local storage (within own fire zone) for local hotel power generation	IGF
	2.2	Local switchboard	Develop switchboard solution for power distribution within one fire zone (partly redundancy required)	Class rules, Electrical Installations
	2.3	Local thermal energy	Develop local thermal energy system within one fire zone (partly redundancy required) Comment 2.3	Class Rules, piping system.
	2.4	Local ventilation system	Develop local ventilation system	Class Rules, piping systems
	2.5	Integration in ships energy grid	Develop integration with remaining auxiliary energy system (available as back-up / redundant supply in the fire zone.	Class rules, Electrical installations and piping systems
	2.6	Generate reliability data	Use service experience from Large Scale technology Demo to generate data for reliability and availability of FC based, distributed power generation system	Observe 2000 hours of running with fire zone wholly powered by FC, and / or accumulated 50 000 FC module hours

Roadmap – PaXell and beyond (4/6)

Activity	Part	Name	Scope	Means
3.		Risk analysis	Perform necessary risk analyses to facilitate deviation from SOLAS rules	In parallel with PaXell Phase II. Need data from PaXell Phase II as input before completion
	3.1	Co-operate with Flag	Choose one flag for performing “Equivalent safety” studies	German Flag?
	3.2	Establish risk analysis team	Establish team as required by MSC 1/Circ.1212, to be approved by Flag.	MSC 1/Circ 1212, item 4
	3.3	Deviation: One main power system.	Perform risk analysis to demonstrate “equivalency”	SOLAS II-1, reg. 55
	3.4	Deviation: One dedicated power system	Perform risk analysis to demonstrate “equivalency”	SOLAS II-1, reg.55
	3.5	Deviation: Emergency power system not normally used for other purposes	Perform risk analysis to demonstrate that redundant DiPoGen gives equivalent or better availability	SOLAS II-1, reg.55
	3.6	Deviation: Fuel flash point above 42 degC (Use of low flash point fuels)	Base on risk analysis/arguments used in BunGas and Gaspax project. Perform risk analysis.	SOLAS II-1, reg.55
	3.5	Insert service experience data	Use data for experienced reliability from Activity 2	MSC / Circ.1032

Roadmap – PaXell and beyond (5/6)

Activity	Part	Name	Scope	Means
4		Full scale Distributed Power arrangement	Develop and demonstrate use of distributed fuel cell arrangement as Ships Auxiliary Energy System	2018 – 2024 (?)
	4.1	Integration	Develop arrangement to allow exchange of energy between fire zones, one or more fire zones acting as back-up for other zones	PaXell Phase 3
	4.2	Back-up	Maintain possibility to connect central energy system for back-up / redundancy	PaXell Phase 3
	4.3	Fuel sharing	Consider need for fuel sharing between fire zones (or shall each zone local fuel tank draw form central tank only?)	PaXell Phase 3 IGF
	4.4	Emergency energy system	Install conventional emergency energy system as back-up while gaining experience with Full Scale DiPoGen.	

Roadmap – PaXell and beyond (6/6))

Activity	Part	Name	Scope	Means
5		Optimized stand-alone DiPoGen	Develop arrangement for optimized safety and redundancy by distributed energy generation system for auxiliary load without conventional back-up	Risk Analysis as per SOLAS II-1, reg. 55, MSC/Circ. 1023 and MSC circ.1212
	5.1	Delete emergency system and possibility for recourse to central energy grid	Local Document, based on experience from act.4, that conventional system is not needed as back-up	Approved risk analysis
	5.2	Perform network safety analyses – Optimize grid configuration	Use tools for energy grid optimization (on land, offshore) to optimize grid configuration.	Optimization
	5.3	Document gain in redundancy / safety compared to conventional energy system	Further risk analyses of optimized configuration.	Further risk analyses / documentation of "beyond compliance"
	5.4	Omit emergency system	Document, based on experience data and analyses from 4 and 5.1 – 5.3 that emergency generator is not needed in DiPoGen	Risk analyses, SOLAS II-1, reg.55
	5.5	Draft SOLAS standard for Distributed Power Generation in passenger ship		New standard, "Beyond compliance"

About the project

- PaXell is run in the frame of the lighthouse project e4ships
- Changing framework conditions for shipping: environmental law limits emission levels
- Cooperation of leading German shipyards, shipping companies, manufacturers of fuel cells and classification societies.
- The total budget for “lighthouse project”:

  35 million €
- Project of the National Innovation Programme for Hydrogen and Fuel Cell Technology (NIP), funded by the Federal Ministry of Transport and Digital Infrastructure (BMVI)

e4ships (nip)
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