

Appendix E

Weight Estimates

WEIGHT ESTIMATE SUMMARIES**Spear SMAR-11N Battery Installation****VESSEL WEIGHT SUMMARY**

BATTERIES	Spear SMAR-11N		
INSTALLED BATTERY ENERGY	6000		kW-hr
COOLING SYSTEM	Air		
WEEKS OF FUEL ABOARD	2		
	WEIGHT (LT)		VCG (ft)
CURRENT LIGHT SHIP	4408		28.44
ADDITIONS	174		20.15
REMOVALS	-76		19.40
NEW LIGHT SHIP	4505	LT	28.27
FULL LOAD CONDITION 5	6184	LT	28.87
REMOVED FUEL	-110	LT	4.94
NEW FULL LOAD CONDITION 5	6172	LT	29.17

SWBS No.	Description	Qty.	Unit	Unit Wt. (lb)	Total Wt. (lb)	Margin	LCG (ft)	VCG (ft)	Source C, E, V	Notes
100	Estimate for Roll and Weld				1,796		0.00	20.15		
190	Battery Support Structure				59,851	10%	0.00	17.05		
313	Batteries				129,682	10%	0.00	20.50		
314	Power Conversion Equipment				126,765	10%	0.00	20.27		
438	Integrated Control Systems and Alarms				1,200	10%	0.00	20.00		
512	Ventilation System				1,880	10%	0.00	25.00		
532	Cooling Water				-	10%				
555	Fire Extinguishing System				8,990	10%	0.00	18.00		
635	Hull Insulation				24,063	10%	0.00	25.75		
					-	0%				
Subgroup-based Margin Total					35,243	10%	0.00	20.15		
Item-based Margin Total					-	0%				
Group Total W/ Margin					389,469	10%	0.00	20.15		

100.0 Hull Structure, General

101.0	Estimate for Roll and Weld	3%		59,851	1,796		0.00	20.15	E	3% per EBDG standard
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190.0 Battery Support Structure

	Support girders - 8x0.25 w 6x.375 flg W	800.4	ft	22.1	17,689			17.00	C	
	Secondary Support Members	600	ft	5.7375	3,443			17.00	C	
	Cap over shaft	2000	ft ²	10.2	20,400			17.00	E	
	Deck plates	1600	ft ²	10.2	16,320			17.00	C	
	Railings	200	ft	10	2,000			18.50	E	

313.0 Batteries

	Spear SMAR-11N	6000	kW-hr	21.6	129682			20.50		
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314.0 Power Conversion Equipment

	Inverter Unit: 2.25MVA	4		4189	16,755			19.00	V	Gamesa E-2.25 MVA
	Step-Up Transformer: 5MVA, 10kV:3.3kV	2	ea	21208	42,417			19.00	V	For reference only
	Switch Gear Section	2	ea	1600	3,200			19.00	E	
	Isolation Transformer	2	ea	21208	42,417			19.00	E	
	Shore Power Connection	2		1800	3,600			28.00	E	
	Shore Power Supply Cable	500	ft	34	17,177			26.00	E	
	Cable supports, guards	2	ea	600	1,200			26.00	E	

438.0 Integrated Control Systems and Alarms

	Control systems, alarms, cables	1	ea	1200	1,200			20.00	E	
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512.0 Ventilation System							
<u>Air Cooled Batteries</u>							
Fans	8	ea	85	680	25.00	E	
Ducting	4	ea	300	1,200	25.00	E	
<u>Water Cooled Batteries</u>							
Fans	4	ea	60		25.00	E	
Ducting	4	ea	160		25.00	E	
532.0 Cooling Water							
Air Cooled Batteries	0	ea	0	-		E	
<u>Water Cooled Batteries</u>							
Piping	600	ft	2.72		16.00	E	
Pump	2	ea	45		16.00	E	
Heat Exchanger	2	ea	140		16.00	E	
Valves, fittings	0.15				16.00	E	
Expansion tank	2	ea	400		16.00	E	
Entrained Fluids	800	gal	8.34		16.00	E	
555.0 Fire Extinguishing System							
555.1 Fixed gas fire extinguishing sys (Novec)	2	ea	2600	5,200	18.00	E	
555.2 Deluge system 3" Sch 40 Pipe	500		7.58	3,790	18.00	E	Includes nozzels Ties into existing sys
635.0 Hull Insulation							
A-60 Insulation over shaft alley	9625	ft	2.5	24,063	25.75	E	Area over shaft Alley
700.0 Other							

SWBS No.	Description	Qty.	Unit	Unit Wt. (lb)	Total Wt. (lb)	Margin	LCG (ft)	VCG (ft)	Source C, E, V	Notes
200	Gensets				137,000	10%	0.00	17.50		
220	Genset support systems				2,274	10%	0.00	16.00		
230	Exhaust System				16,485	10%	0.00	35.69		
240	Fuel				245,486	0%	0.00	4.94		
					-					
Subgroup-based Margin Total					15,576	4%	0.00	19.40		
Item-based Margin Total					-	0%				
Group Total W/ Margin					416,821	4%	0.00	10.89		

200 Gensets										
	Engine	2	ea	40500	81,000			17.50	V	EMD 16-710
	Accessory Rack	2	ea	3700	7,400			17.50	V	EMD 16-710
	Generator (Assumed to be 0.6 of engine wt)	2	ea	24300	48,600			17.50	E	
220 Genset support systems										
	Cooling Piping	150	ft	7.58	1,137			16.00	E	
	Fuel Piping	150	ft	7.58	1,137			16.00	E	
230 Exhaust System										
	Exhaust Piping	200	ft	63.4	12,680			32.00	E	
	Silencers	2	ea	800	1,600			70.00	E	
	Sheathing	200	ft	9.4	1,885			32.00	E	
	Hangers	2	ea	160	320			32.00	E	
240 Fuel										
	Assume vessel carries 1wk less fuel	33824	gal	7.26	245,486			4.94	C	

Spear SMAR-3T Battery Installation**VESSEL WEIGHT SUMMARY**

BATTERIES	Spear SMAR-3T		
INSTALLED BATTERY ENERGY	3000		kW-hr
COOLING SYSTEM	Air		
WEEKS OF FUEL ABOARD	2		
	WEIGHT (LT)		VCG (ft)
CURRENT LIGHT SHIP	4408		28.44
ADDITIONS	178		20.16
REMOVALS	-76		19.40
NEW LIGHT SHIP	4509	LT	28.27
FULL LOAD CONDITION 5	6184	LT	28.87
REMOVED FUEL	-110	LT	4.94
NEW FULL LOAD CONDITION 5	6176	LT	29.16

SWBS No.	Description	Qty.	Unit	Unit Wt. (lb)	Total Wt. (lb)	Margin	LCG (ft)	VCG (ft)	Source C, E, V	Notes
100	Estimate for Roll and Weld				1,796		0.00	20.16		
190	Battery Support Structure				59,851	10%	0.00	17.05		
313	Batteries				137,788	10%	0.00	20.50		
314	Power Conversion Equipment				126,765	10%	0.00	20.27		
438	Integrated Control Systems and Alarms				1,200	10%	0.00	20.00		
512	Ventilation System				1,880	10%	0.00	25.00		
532	Cooling Water				-	10%				
555	Fire Extinguishing System				8,990	10%	0.00	18.00		
635	Hull Insulation				24,063	10%	0.00	25.75		
					-	0%				
Subgroup-based Margin Total					36,054	10%	0.00	20.16		
Item-based Margin Total					-	0%				
Group Total W/ Margin					398,385	10%	0.00	20.16		

100.0 Hull Structure, General

101.0	Estimate for Roll and Weld	3%		59,851	1,796		0.00	20.16	E	3% per EBDG standard
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190.0 Battery Support Structure

	Support girders - 8x0.25 w 6x.375 flg W	800.4	ft	22.1	17,689			17.00	C	
	Secondary Support Members	600	ft	5.7375	3,443			17.00	C	
	Cap over shaft	2000	ft²	10.2	20,400			17.00	E	
	Deck plates	1600	ft²	10.2	16,320			17.00	C	
	Railings	200	ft	10	2,000			18.50	E	

313.0 Batteries

	Spear SMAR-3T	3000	kW-hr	45.9	137788			20.50		
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314.0 Power Conversion Equipment

	Inverter Unit: 2.25MVA	4		4189	16,755			19.00	V	Gamesa E-2.25 MVA
	Step-Up Transformer: 5MVA, 10kV:3.3kV	2	ea	21208	42,417			19.00	V	For reference only
	Switch Gear Section	2	ea	1600	3,200			19.00	E	
	Isolation Transformer	2	ea	21208	42,417			19.00	E	
	Shore Power Connection	2		1800	3,600			28.00	E	
	Shore Power Supply Cable	500	ft	34	17,177			26.00	E	
	Cable supports, guards	2	ea	600	1,200			26.00	E	

438.0 Integrated Control Systems and Alarms

	Control systems, alarms, cables	1	ea	1200	1,200			20.00	E	
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512.0 Ventilation System							
<u>Air Cooled Batteries</u>							
Fans	8	ea	85	680	25.00	E	
Ducting	4	ea	300	1,200	25.00	E	
<u>Water Cooled Batteries</u>							
Fans	4	ea	60		25.00	E	
Ducting	4	ea	160		25.00	E	
532.0 Cooling Water							
Air Cooled Batteries	0	ea	0	-		E	
<u>Water Cooled Batteries</u>							
Piping	600	ft	2.72		16.00	E	
Pump	2	ea	45		16.00	E	
Heat Exchanger	2	ea	140		16.00	E	
Valves, fittings	0.15				16.00	E	
Expansion tank	2	ea	400		16.00	E	
Entrained Fluids	800	gal	8.34		16.00	E	
555.0 Fire Extinguishing System							
555.1 Fixed gas fire extinguishing sys (Novec)	2	ea	2600	5,200	18.00	E	
555.2 Deluge system 3" Sch 40 Pipe	500		7.58	3,790	18.00	E	Includes nozzels Ties into existing sys
635.0 Hull Insulation							
A-60 Insulation over shaft alley	9625	ft	2.5	24,063	25.75	E	Area over shaft Alley
700.0 Other							

SWBS No.	Description	Qty.	Unit	Unit Wt. (lb)	Total Wt. (lb)	Margin	LCG (ft)	VCG (ft)	Source C, E, V	Notes
200	Gensets				137,000	10%	0.00	17.50		
220	Genset support systems				2,274	10%	0.00	16.00		
230	Exhaust System				16,485	10%	0.00	35.69		
240	Fuel				245,486	0%	0.00	4.94		
					-					
Subgroup-based Margin Total					15,576	4%	0.00	19.40		
Item-based Margin Total					-	0%				
Group Total W/ Margin					416,821	4%	0.00	10.89		

200 Gensets										
	Engine	2	ea	40500	81,000			17.50	V	EMD 16-710
	Accessory Rack	2	ea	3700	7,400			17.50	V	EMD 16-710
	Generator (Assumed to be 0.6 of engine wt)	2	ea	24300	48,600			17.50	E	
220 Genset support systems										
	Cooling Piping	150	ft	7.58	1,137			16.00	E	
	Fuel Piping	150	ft	7.58	1,137			16.00	E	
230 Exhaust System										
	Exhaust Piping	200	ft	63.4	12,680			32.00	E	
	Silencers	2	ea	800	1,600			70.00	E	
	Sheathing	200	ft	9.4	1,885			32.00	E	
	Hangers	2	ea	160	320			32.00	E	
240 Fuel										
	Assume vessel carries 1wk less fuel	33824	gal	7.26	245,486			4.94	C	

PBES Power 65 Battery Installation**VESSEL WEIGHT SUMMARY**

BATTERIES	PBES, liquid cooled rack		
INSTALLED BATTERY ENERGY	6000		kW-hr
COOLING SYSTEM	Water		
WEEKS OF FUEL ABOARD	2		
	WEIGHT (LT)		VCG (ft)
CURRENT LIGHT SHIP	4408		28.44
ADDITIONS	209		20.09
REMOVALS	-76		19.40
NEW LIGHT SHIP	4541	LT	28.21
FULL LOAD CONDITION 5	6184	LT	28.87
REMOVED FUEL	-110	LT	4.94
NEW FULL LOAD CONDITION 5	6208	LT	29.11

SWBS No.	Description	Qty.	Unit	Unit Wt. (lb)	Total Wt. (lb)	Margin	LCG (ft)	VCG (ft)	Source C, E, V	Notes
100	Estimate for Roll and Weld				1,796		0.00	20.09		
190	Battery Support Structure				59,851	10%	0.00	17.05		
313	Batteries				193,326	10%	0.00	20.50		
314	Power Conversion Equipment				126,765	10%	0.00	20.27		
438	Integrated Control Systems and Alarms				1,200	10%	0.00	20.00		
512	Ventilation System				880	10%	0.00	25.00		
532	Cooling Water				9,721	10%	0.00	16.00		
555	Fire Extinguishing System				8,990	10%	0.00	18.00		
635	Hull Insulation				24,063	10%	0.00	25.75		
					-	0%				
Subgroup-based Margin Total					42,480	10%	0.00	20.09		
Item-based Margin Total					-	0%				
Group Total W/ Margin					469,071	10%	0.00	20.09		

100.0 Hull Structure, General

101.0	Estimate for Roll and Weld	3%		59,851	1,796		0.00	20.09	E	3% per EBDG standard
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190.0 Battery Support Structure

	Support girders - 8x0.25 w 6x.375 flg W	800.4	ft	22.1	17,689			17.00	C	
	Secondary Support Members	600	ft	5.7375	3,443			17.00	C	
	Cap over shaft	2000	ft ²	10.2	20,400			17.00	E	
	Deck plates	1600	ft ²	10.2	16,320			17.00	C	
	Railings	200	ft	10	2,000			18.50	E	

313.0 Batteries

	PBES, liquid cooled rack	6000	kW-hr	32.2	193326			20.50		
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314.0 Power Conversion Equipment

	Inverter Unit: 2.25MVA	4		4189	16,755			19.00	V	Gamesa E-2.25 MVA
	Step-Up Transformer: 5MVA, 10kV:3.3kV	2	ea	21208	42,417			19.00	V	For reference only
	Switch Gear Section	2	ea	1600	3,200			19.00	E	
	Isolation Transformer	2	ea	21208	42,417			19.00	E	
	Shore Power Connection	2		1800	3,600			28.00	E	
	Shore Power Supply Cable	500	ft	34	17,177			26.00	E	
	Cable supports, guards	2	ea	600	1,200			26.00	E	

438.0 Integrated Control Systems and Alarms

	Control systems, alarms, cables	1	ea	1200	1,200			20.00	E	
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512.0 Ventilation System							
<u>Air Cooled Batteries</u>							
Fans	8	ea	85			25.00	E
Ducting	4	ea	300			25.00	E
<u>Water Cooled Batteries</u>							
Fans	4	ea	60	240		25.00	E
Ducting	4	ea	160	640		25.00	E
532.0 Cooling Water							
Air Cooled Batteries	0	ea	0	-			E
<u>Water Cooled Batteries</u>							
Piping	600	ft	2.72	1,632		16.00	E
Pump	2	ea	45	90		16.00	E
Heat Exchanger	2	ea	140	280		16.00	E
Valves, fittings	0.15		1,632	245		16.00	E
Expansion tank	2	ea	400	800		16.00	E
Entrained Fluids	800	gal	8.34	6,674		16.00	E
555.0 Fire Extinguishing System							
555.1 Fixed gas fire extinguishing sys (Novec)	2	ea	2600	5,200		18.00	E
555.2 Deluge system 3" Sch 40 Pipe	500		7.58	3,790		18.00	E Includes nozzels Ties into existing sys
635.0 Hull Insulation							
A-60 Insulation over shaft alley	9625	ft	2.5	24,063		25.75	E Area over shaft Alley
700.0 Other							

SWBS No.	Description	Qty.	Unit	Unit Wt. (lb)	Total Wt. (lb)	Margin	LCG (ft)	VCG (ft)	Source C, E, V	Notes
200	Gensets				137,000	10%	0.00	17.50		
220	Genset support systems				2,274	10%	0.00	16.00		
230	Exhaust System				16,485	10%	0.00	35.69		
240	Fuel				245,486	0%	0.00	4.94		
					-					
Subgroup-based Margin Total					15,576	4%	0.00	19.40		
Item-based Margin Total					-	0%				
Group Total W/ Margin					416,821	4%	0.00	10.89		

200 Gensets										
	Engine	2	ea	40500	81,000			17.50	V	EMD 16-710
	Accessory Rack	2	ea	3700	7,400			17.50	V	EMD 16-710
	Generator (Assumed to be 0.6 of engine wt)	2	ea	24300	48,600			17.50	E	
220 Genset support systems										
	Cooling Piping	150	ft	7.58	1,137			16.00	E	
	Fuel Piping	150	ft	7.58	1,137			16.00	E	
230 Exhaust System										
	Exhaust Piping	200	ft	63.4	12,680			32.00	E	
	Silencers	2	ea	800	1,600			70.00	E	
	Sheathing	200	ft	9.4	1,885			32.00	E	
	Hangers	2	ea	160	320			32.00	E	
240 Fuel										
	Assume vessel carries 1wk less fuel	33824	gal	7.26	245,486			4.94	C	

Corvus Orca Energy Battery Installation**VESSEL WEIGHT SUMMARY**

BATTERIES	Corvus Orca Energy, liquid cooled rack	
INSTALLED BATTERY ENERGY	6000	kW-hr
COOLING SYSTEM	Water	
WEEKS OF FUEL ABOARD	2	

	WEIGHT (LT)		VCG (ft)
CURRENT LIGHT SHIP	4408		28.44
ADDITIONS	195		20.06
REMOVALS	-76		19.40
NEW LIGHT SHIP	4527	LT	28.23
FULL LOAD CONDITION 5	6184	LT	28.87
REMOVED FUEL	-110	LT	4.94
NEW FULL LOAD CONDITION 5	6193	LT	29.13

SWBS No.	Description	Qty.	Unit	Unit Wt. (lb)	Total Wt. (lb)	Margin	LCG (ft)	VCG (ft)	Source C, E, V	Notes
100	Estimate for Roll and Weld				1,796		0.00	20.06		
190	Battery Support Structure				59,851	10%	0.00	17.05		
313	Batteries				164,022	10%	0.00	20.50		
314	Power Conversion Equipment				126,765	10%	0.00	20.27		
438	Integrated Control Systems and Alarms				1,200	10%	0.00	20.00		
512	Ventilation System				880	10%	0.00	25.00		
532	Cooling Water				9,721	10%	0.00	16.00		
555	Fire Extinguishing System				8,990	10%	0.00	18.00		
635	Hull Insulation				24,063	10%	0.00	25.75		
					-	0%				
Subgroup-based Margin Total					39,549	10%	0.00	20.06		
Item-based Margin Total					-	0%				
Group Total W/ Margin					436,836	10%	0.00	20.06		

100.0 Hull Structure, General

101.0	Estimate for Roll and Weld	3%		59,851	1,796		0.00	20.06	E	3% per EBDG standard
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190.0 Battery Support Structure

	Support girders - 8x0.25 w 6x.375 flg W	800.4	ft	22.1	17,689			17.00	C	
	Secondary Support Members	600	ft	5.7375	3,443			17.00	C	
	Cap over shaft	2000	ft ²	10.2	20,400			17.00	E	
	Deck plates	1600	ft ²	10.2	16,320			17.00	C	
	Railings	200	ft	10	2,000			18.50	E	

313.0 Batteries

	Corvus Orca Energy, liquid cooled rack	6000	kW-hr	27.3	164022			20.50		
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314.0 Power Conversion Equipment

	Inverter Unit: 2.25MVA	4		4189	16,755			19.00	V	Gamesa E-2.25 MVA
	Step-Up Transformer: 5MVA, 10kV:3.3kV	2	ea	21208	42,417			19.00	V	For reference only
	Switch Gear Section	2	ea	1600	3,200			19.00	E	
	Isolation Transformer	2	ea	21208	42,417			19.00	E	
	Shore Power Connection	2		1800	3,600			28.00	E	
	Shore Power Supply Cable	500	ft	34	17,177			26.00	E	
	Cable supports, guards	2	ea	600	1,200			26.00	E	

438.0 Integrated Control Systems and Alarms

	Control systems, alarms, cables	1	ea	1200	1,200			20.00	E	
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512.0 Ventilation System							
<u>Air Cooled Batteries</u>							
Fans	8	ea	85			25.00	E
Ducting	4	ea	300			25.00	E
<u>Water Cooled Batteries</u>							
Fans	4	ea	60	240		25.00	E
Ducting	4	ea	160	640		25.00	E
532.0 Cooling Water							
Air Cooled Batteries	0	ea	0	-			E
<u>Water Cooled Batteries</u>							
Piping	600	ft	2.72	1,632		16.00	E
Pump	2	ea	45	90		16.00	E
Heat Exchanger	2	ea	140	280		16.00	E
Valves, fittings	0.15		1,632	245		16.00	E
Expansion tank	2	ea	400	800		16.00	E
Entrained Fluids	800	gal	8.34	6,674		16.00	E
555.0 Fire Extinguishing System							
555.1 Fixed gas fire extinguishing sys (Novec)	2	ea	2600	5,200		18.00	E
555.2 Deluge system 3" Sch 40 Pipe	500		7.58	3,790		18.00	E Includes nozzels Ties into existing sys
635.0 Hull Insulation							
A-60 Insulation over shaft alley	9625	ft	2.5	24,063		25.75	E Area over shaft Alley
700.0 Other							

SWBS No.	Description	Qty.	Unit	Unit Wt. (lb)	Total Wt. (lb)	Margin	LCG (ft)	VCG (ft)	Source C, E, V	Notes
200	Gensets				137,000	10%	0.00	17.50		
220	Genset support systems				2,274	10%	0.00	16.00		
230	Exhaust System				16,485	10%	0.00	35.69		
240	Fuel				245,486	0%	0.00	4.94		
					-					
Subgroup-based Margin Total					15,576	4%	0.00	19.40		
Item-based Margin Total					-	0%				
Group Total W/ Margin					416,821	4%	0.00	10.89		

200 Gensets										
	Engine	2	ea	40500	81,000			17.50	V	EMD 16-710
	Accessory Rack	2	ea	3700	7,400			17.50	V	EMD 16-710
	Generator (Assumed to be 0.6 of engine wt)	2	ea	24300	48,600			17.50	E	
220 Genset support systems										
	Cooling Piping	150	ft	7.58	1,137			16.00	E	
	Fuel Piping	150	ft	7.58	1,137			16.00	E	
230 Exhaust System										
	Exhaust Piping	200	ft	63.4	12,680			32.00	E	
	Silencers	2	ea	800	1,600			70.00	E	
	Sheathing	200	ft	9.4	1,885			32.00	E	
	Hangers	2	ea	160	320			32.00	E	
240 Fuel										
	Assume vessel carries 1wk less fuel	33824	gal	7.26	245,486			4.94	C	

Appendix F

Regulatory Review

REGULATORY REVIEW COMPARISON

DNV Rules for Classification of Ships: Part 6, Chapter 2 [18]		BV Part F, Chapter 11, Sections 21 and 22 [59]		ABS Guide for Use of Lithium Batteries in the Marine and Offshore Industries [20]	
1. Essential services located in the battery space					
Section 2.2.2 Cannot contain other systems supporting essential vessel services in order to prevent loss of propulsion or steering upon possible incidents in the battery system.		Section 21/3.1.2 It should not be possible to have sea water entering battery compartment. Piping systems not involved in battery operation are not to be located in the battery compartment.		Section 3.3(iii) Cannot contain any equipment supporting essential services, so as to prevent loss of such essential services in the event of an incident.	
2. Ventilation for non-water-cooled batteries					
Section 2.3.1.5 Ventilation for the space (for non-water-cooled batteries) must be set up for automatic shutdown upon fire detection.		Section 21/3.1.1 References ventilation requirements for lead acid batteries (Pt C, Ch. 2, Section 11). Requirements for thermal runaway events are not addressed.		Section 3.3(ix) References ventilation requirements for lead acid batteries (ABS SVR 4-8-4/5.3.1). Requirements for thermal runaway events are not addressed.	
3. Ventilation for water-cooled batteries					
Section 2.3.1.7 An independent ventilation system is required for possible vapors from a thermal runaway event.		Section 21/3.1.1 References ventilation requirements for lead acid batteries (Pt C, Ch. 2, Section 11). Requirements for thermal runaway events are not addressed.		Section 3.3(ix) References ventilation requirements for lead acid batteries (ABS SVR 4-8-4/5.3.1). Requirements for thermal runaway events are not addressed.	
4. Hazardous spaces					
Section 2.3.2.1 Possible classification of the battery space as a hazardous zone per IEC 60079 requiring explosion proof equipment depending on the chemistry of the batteries.		Section 21/3.1.1 Possible classification of the battery space as a hazardous zone per IEC 60079 requiring explosion proof equipment depending on the chemistry of the batteries.		Section 3.3.3 Possible classification of the battery space as a hazardous zone per IEC 60079 requiring explosion proof equipment depending on the chemistry of the batteries.	
5. Gas detection					
Section 2.3.2.3 Gas detection will likely be required.		Section 21/3.1.1 Gas detection will likely be required.		Section 3.3(x) Gas detection will likely be required.	
6. Structural fire protection					
Section 2.4.1.2 & 2.4.1.3 Battery spaces must be enclosed to A-0, as well as A-60 towards muster and evacuation stations for a Battery(Safety) notation and A-60 towards machinery spaces for Battery (Power) notation.		Section 21/3.1.5 In accordance with structural fire protection for "Other machinery spaces." At a minimum A-0 boundaries are to be fitted between two battery compartments.		Section 3.3.1(i) Considered an Auxiliary Machinery Space or a Machinery Space other than category A as defined in SOLAS Regulation II-2 and is subject to those structural fire protection requirements.	
7. Firefighting					
Section 2.4.3.1 Battery space must have a fixed fire extinguishing system. Currently requires a water-based system, but alternative systems could be considered.		Section 21/3.1.5 Battery space must have a fixed fire extinguishing system. Currently requires a gas system, but states "fluid employed is to be compatible with technology of the battery employed."		Section 3.3.1(ii) Battery space must have a fixed fire extinguishing system that is recommended by the vendor and appropriate to the battery chemistry.	

8. Emergency shutdowns		
Section 4.1.5.1 For the Battery (Safety) notation "Battery Protective System" alarms shall cause a shutdown. For batteries used for essential services, such alarms shall NOT cause a shutdown.	Section 22/3.6.3 & Table 2 Requires control and monitoring for different system parameters. Shutdowns are required for short circuit currents, overloads, overvoltage, and under voltage.	Section 2.1.1(iii) An independent emergency shutdown mechanism outside of the battery space is required. Additional shutdowns required on the navigation bridge and at the EOS when batteries are used for propulsion. No requirement for automatic shutdowns.
9. Battery testing – IEC 62619 [59]		
Section 4.2.3 Lithium based batteries must meet IEC 62619, including its cell-to-cell propagation tests.	Section 21/5.1.2 Lithium based batteries must only be tested per "a National or International standard. If such a standard is not available, the manufacturer's specifications are to be submitted to the society."	Section 2.1.1(iii) Lithium based batteries must undergo a number of tests in IEC 62619.