Manwearable Power for Dismounted Soldiers

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For QinetiQ (UK) and MoD (UK)

JSPE August 2015

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DSS Manwearable Power - the problem.

The sharp rise in Soldier worn capability has resulted in a proliferation of power systems

This current trend is unsustainable and compounded by:

- Lack of soldier confidence in batteries
- No effective means to generate power in an austere environment
- Too many battery types with differing interfaces (lack of Standardisation)

Consequences of an unbearable load:

- Trade offs in terms of mobility, lethality, agility
- Decreased range, endurance, mission limitations
- Increased fatigue
- Frequent interruptions to change batteries
- Increased procurement costs
- Additional Logistic burden

Endangers mission success and can cost lives

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Manwearable/Manportable Architecture - Centralised Power

Currently. DSS power is provided by individual batteries but the advent of intelligent textiles has provided a capability for multiple items of equipment to be connected to a centralised power source without the need for numerous interconnecting cables.

Benefits. Centralised power can be provided to a common supply circuit to reduce the soldier weight burden. It will have the added advantage of reducing the inventory, easing logistic support and also reducing commodity re-supply costs. It is envisaged that the centralised power hub will directly power lower drain devices (incorporating dc to dc conversion when necessary) and provide supplementary 'top-up' charge to higher power devices e.g. radios. Depending on the capability of the power source it may also be possible to directly support the low power (squad) radios.

Charging on the Move. A centralised power hub allows for a single point of charging and it is therefore possible to develop a means of on-man charging by ancillary systems such as energy harvesting devices, power managers, low weight fuel cells or alternative power systems carried in the Bergen; or potentially power inductive loops within the vest coupled with a vehicle seat.

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Earlier Power Assessments – Mapes 2012.

Estimated Power Requirements of Land Warrior System, by Function
From Mapes, (2012) "OEF Afghanistan, 72 Hour Mission"

Equipment	Battery Type	Battery Qty	Weight		Avg Power
			(lbs)	(kg)	(Watts)
AN/PVS 14 (Night Vision)	AA	2	0.106	0.048	0.04
Mark VII	Lithium 3.9V	1	0.256	0.116	0.167
MBITR	BB 521	8	6.4	2.903	5.33
Light (Sure Fire)	CR-123A	6	0.222	0.101	0.219
Light (Maglite)	AA	2	0.106	0.048	0.019
GPS (DAGR)	AA+1/2AA	24	1.3	0.590	0.729
Head Set	AA	2	0.106	0.048	0.19
PEQ-2A	AA	2	0.106	0.048	0.011
Night rfle scope (HTWS)	AA Li-FeS	12	0.384	0.174	0.68
Day rifle scope (M68 CCO)	DL 1/3N	1	0.007	0.003	0.00006
Radio (LMR)	3600 NiMH	8	6.4	2.903	1.15
P-Beacon	9V	1	0.1	0.045	0.049
TOTAL			15.49	7.03	8.58
			Mission Hrs	72.00 Hr	618.05 Whr

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Battery Utilisation Assessment - the argument for central power.

Equipment	Battery Type	Battery Qty	Weight	Avg Power	Energy		
					Available	Used (72hr)	Used
			[kg]	[W]	[Wh]	[Wh]	[%]
AN/PVS 14 (Night Vision)	AA	2	0.048	0.04	8.55	2.88	34
Mark VII (Laser Target Locator)	Lithium 3.9V	1	0.116	0.167	21.46	12.024	56
MBITR(Multiband Inter/Intra Team Radio)	BB 521	8	2.902	0.533	92.16	38.376	42
Light (Sure Fire)	CR-123A	6	0.100	0.219	27	15.768	58
Light (Maglite)	AA	2	0.048	0.019	8.55	1.368	16
GPS (DAGR)	AA +1/2AA	24	0.589	0.729	102.6	52.488	51
Head Set	AA	2	0.048	0.019	8.55	1.368	16
PEQ-2A	AA	2	0.048	0.011	8.55	0.792	9
Night rifle scope (HTWS)	AA Li-FeS	12	0.174	0.68	54	48.96	91
Day rifle scope (M68 CCO)	DL 1/3N	1	0.003	0.00006	0.48	0.00432	1
Land Mobile Radio (LMR)	3600 NiMH	8	2.902	1.15	207.36	82.8	40
P-Beacon (Emergency Locator)	9V [10]	1	0.045	0.049	5.085	3.528	69
TOTAL			7.03	3.62	544.3	260.3	48

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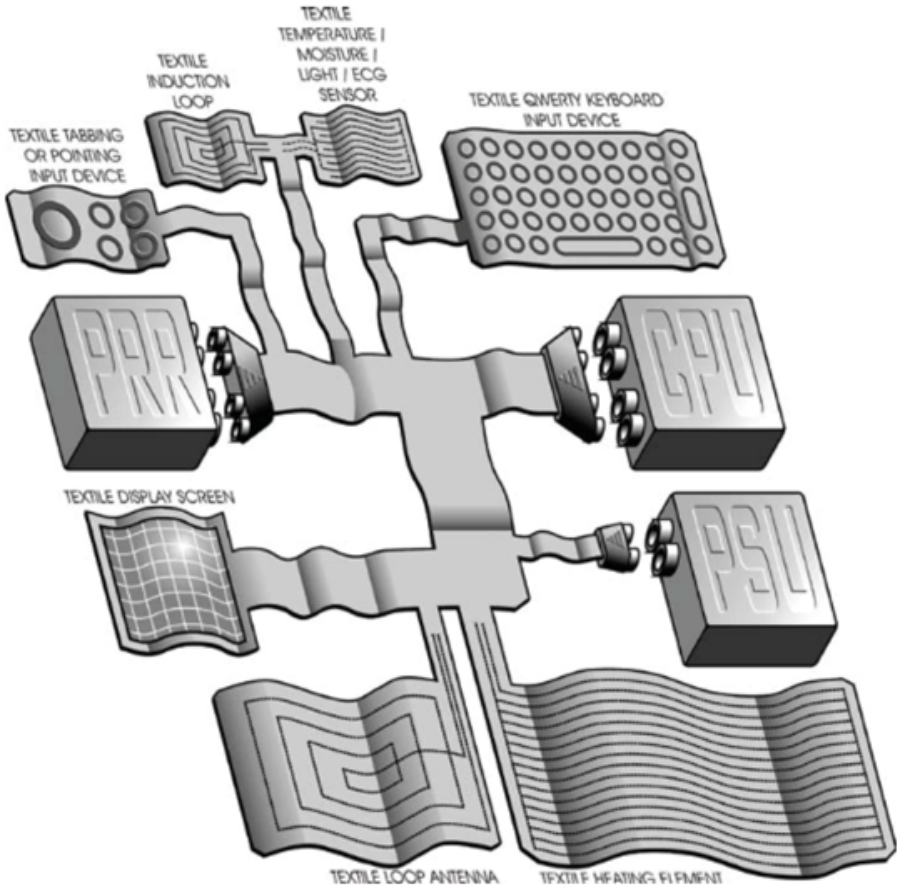
Centralised Power – An example (courtesy of RUSI)



RUSI Infantry: Capability, Burden and Technology, Intelligent Textiles: Reducing the Burden, Dr Stan Swallow and Asha Peta Thompson, February 2010.

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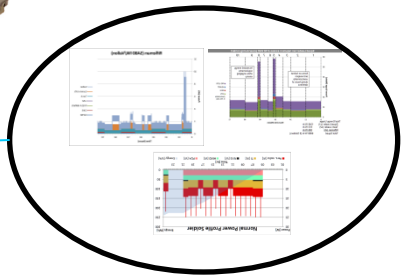
Presentation Overview

Centralised Power

2W, 5W, 10W 10/40W & 20W

Load Definition



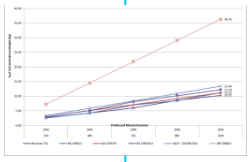
Consult with SET 206 members and Industry

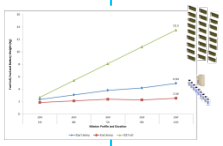
Test Vehicles

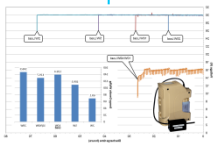
Primary Systems

Rechargeable Systems

Fuel Cells







Lowest Weight
Comparable footprint
Logistical Burden
Disposal

Heavier than Primary,
Re-useable,
Charge on the GO
Capacity Improvement

Significant weight reduction
Continuity Risk (Generator)
Higher Cost
Maturity/Reliability
Consumable Fuel

Ministry of Defence de&S

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Reference Data used to determine the loads required

Determination of the DSS power source load profile.

References:

- Electrical Power Supply for Military Ground Troops; Carl Gustaf Rye-Florentz; Oslo, Norway 16 May 2010.
- 130520.DCC RF BFM Power Consumption Database Issue 1.1 (UK)
- NSRDEC 2021 Power and Data Architecture Study, NSRDEC and Draper Collaboration; Section 2: 2013 Baseline Equipment and Usage Study; 21/10/13 (US)
- Dismounted Soldier Systems Standing Instruction 103 – Power Budget Issue 3, December 2014 (author reviewing data)

Lets look at these in more detail…….

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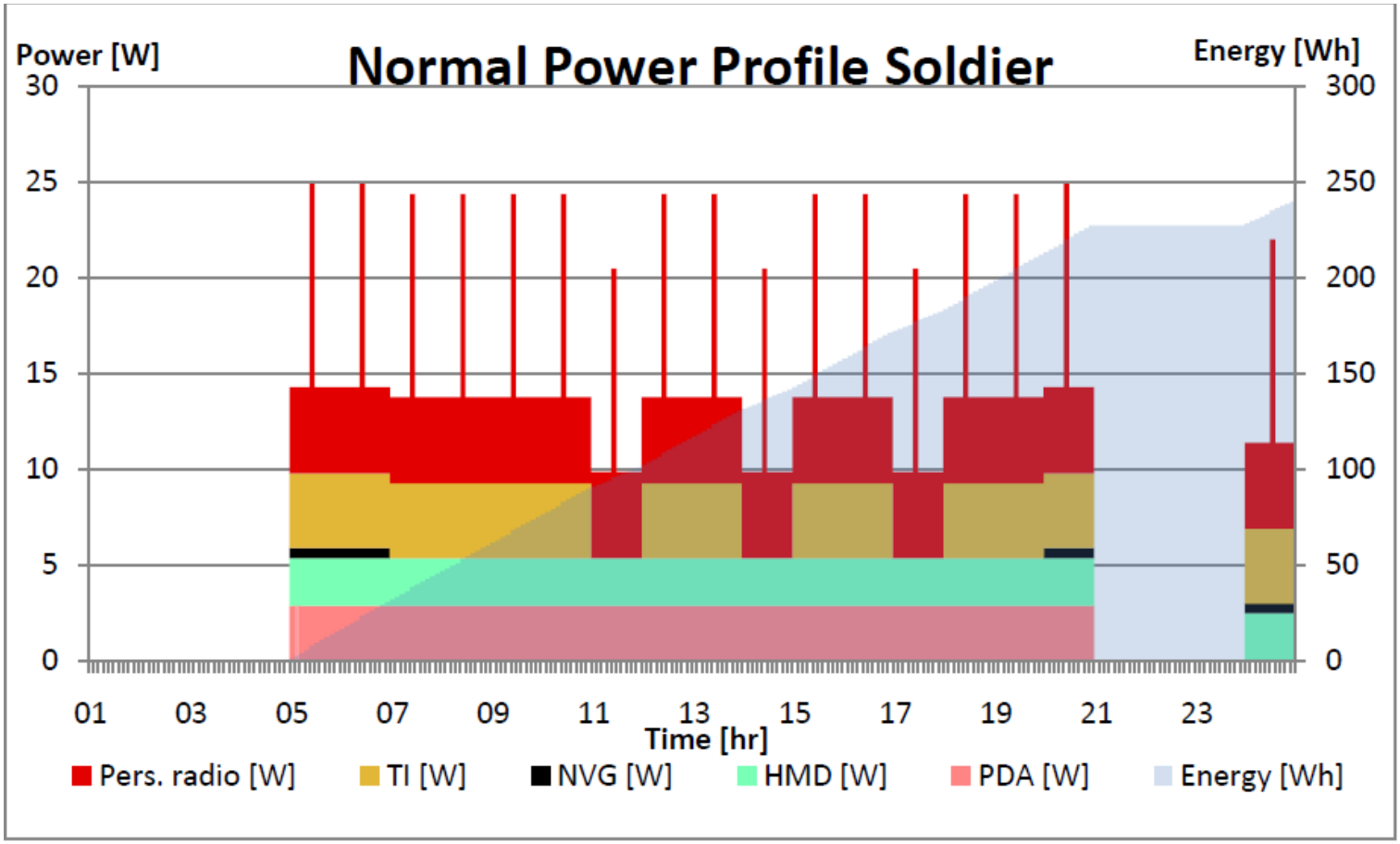
Norwegian - Normal Power Profile



The average power level, when active is around 14 W, with a maximum power level of 25 W.
The total energy consumption is 250 Wh/day per soldier (Analysis concluded 250/24=10.4W)

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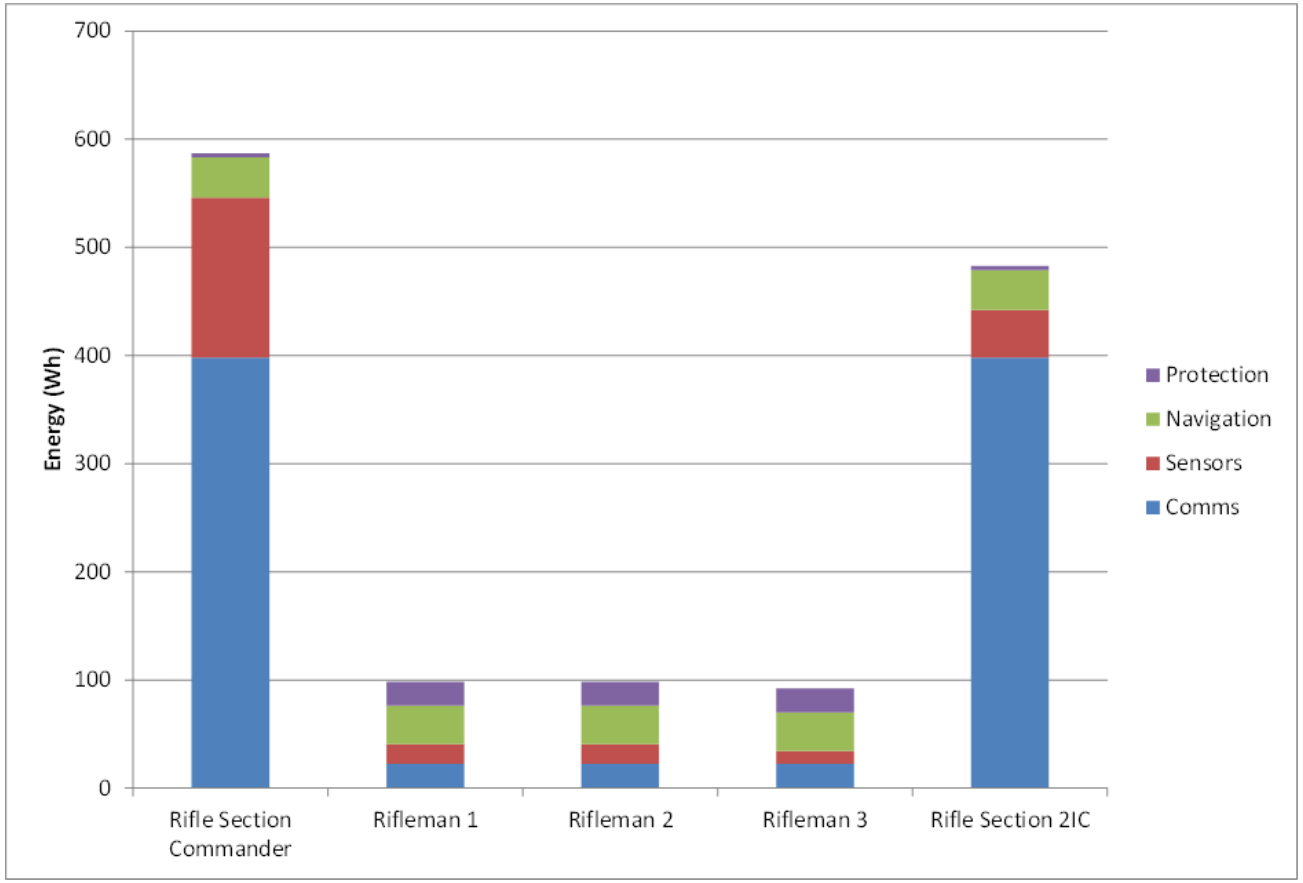
UK Section Commander Load Profile – BFM Assessment



The power consumption recorded over a 72h period for each role.

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NSRDEC Calculation for a 72 hour mission requirement.

EQUIPMENT POWER REQUIREMENT

Equipment	Power (W)
PRC-117G	
Transmit	65
Receive	5.2
Standby	5.2
PRC-154	
Transmit	40
Receive	4.5
Standby	4.5
Peltor Headset	0.0072
EUD (Samsung Note)	
Screen On	0.765
Screen Off	0.015
M150 AOG	0
M68 CCO	0.002
AN/PAS-13 LTWS	1.5
DAGR	
Acquiring	1.1
Tracking	0.9
PVS-20	
Image Intensifier	1.2
II and Infrared	2.4
PEQ-2A	
High	1.5
Low	0.75
Flashlight (Rifle)	2.5
Flashlight (Helmet)	0.16

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EQUIPMENT USAGE BY ACTIVITY

	March	Camp Activities	Rest	Scout	Surveillance	Move to Contact	React to Contact
PRC-117	100%	100%	100%	100%	100%	100%	100%
Transmit	5%	5%	5%	20%	20%	50%	50%
Receive	5%	5%	5%	20%	20%	50%	50%
Standby	90%	90%	90%	60%	60%	0%	0%
PRC-154	100%	100%	100%	100%	100%	100%	100%
Transmit	10%	10%	0%	20%	20%	33%	33%
Receive	30%	30%	10%	40%	40%	67%	67%
Standby	60%	60%	90%	40%	40%	0%	0%
Peltor Headset	100%	100%	100%	100%	100%	100%	100%
EUD	100%	100%	100%	100%	100%	100%	100%
Screen On	10%	10%	0%	30%	30%	50%	50%
Screen Off	90%	90%	100%	70%	70%	50%	50%
AN-PAS 13 LTWS	0%	50%	0%	100%	100%	100%	100%
DAGR	100%	0%	0%	100%	100%	100%	100%
Acquiring	1%	0%	0%	1%	1%	1%	1%
Tracking	99%	0%	0%	99%	99%	99%	99%
PVS-20	100%	100%	0%	100%	100%	100%	100%
Image Intensifier	100%	100%	0%	100%	100%	0%	0%
II and Infrared	0%	0%	0%	0%	0%	100%	100%
PEQ-2A	0%	50%	0%	0%	0%	100%	100%
High	0%	0%	0%	0%	0%	100%	100%
Low	0%	50%	0%	0%	0%	0%	0%
Flashlight (Rifle)	0%	10%	0%	0%	0%	50%	50%
Flashlight (Helmet)	0%	20%	0%	0%	0%	50%	50%

X

ACTIVITY BY PHASE

Phase		March	Camp Activities	Rest	Scout	Surveillance	Move to Contact	React to Contact
Phase 1 Movement to PB1	12 hours	67% (8 hours)		33% (4 hours)				
Phase 2 Occupy PB1	12 hours		50% (6 hours)	50% (6 hours)				
Phase 3 Movement to ORP	6 hours	67% (4 hours)		33% (2 hours)				
Phase 4 Occupy ORP	6 hours		33% (2 hours)	33% (2 hours)	17% (1 hours)	17% (1 hours)		
Phase 5 Attack OBJ at EA 1	2 hours						100% (2 hours)	
Phase 6 Reconsolidate at ORP	4 hours		50% (2 hours)	50% (2 hours)				
Phase 7 Movement to PB2	6 hours	67% (4 hours)		33% (2 hours)				
Phase 8 React to Contact at EA 2	2 hours							100% (2 hours)
Phase 9 Occupy PB2	10 hours		50% (5 hours)	50% (5 hours)				
Phase 10 Movement to AA	12 hours	67% (8 hours)		33% (4 hours)				

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TOTAL ENERGY REQUIRED PER PIECE OF EQUIPMENT FOR 72 HOUR MISSION

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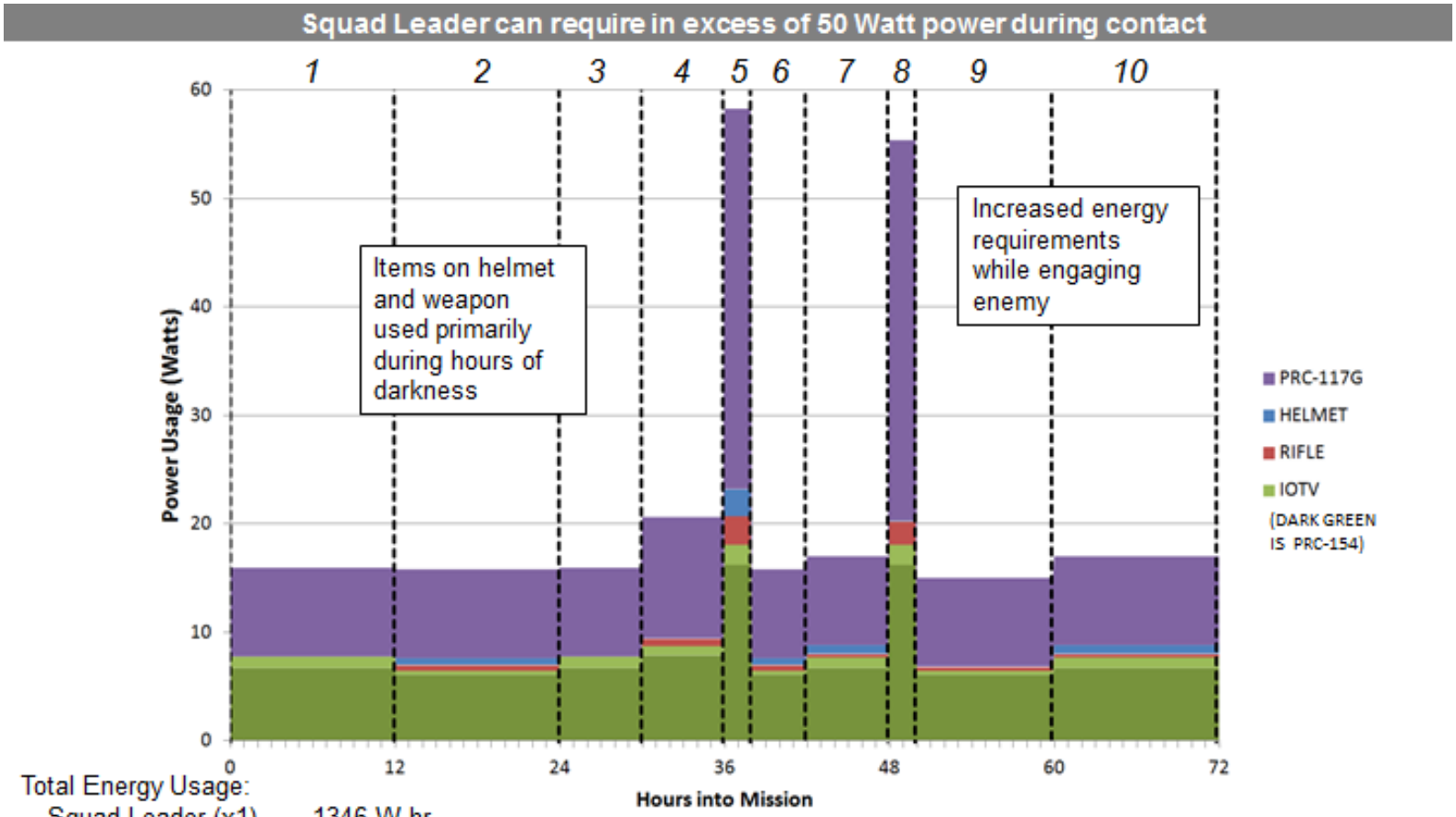
Power Usage Profile – 72 hour mission



Total Energy Usage:

Squad Leader (x1)	1346 W-hr
Team Leader (x2)	613 W-hr
Rifleman (x6)	586 W-hr
Total Squad	6088 W-hr (9 Soldiers)

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Load Profile Assessment – Consolidated Requirement

1. *In all cases the power profile comprises an average continuous load with superimposed peaks. The peaks are generally associated with communication equipment which for the purposes of this exercise will have autonomous operation i.e. the high power radio battery will only receive a top up charge from the centralised battery.*

2. *Simulating composite loads may require specialised test equipment. The proposal is therefore to use constant power loads. The profiles have been streamlined into three distinct groups:*

    a. *2W continuous (UK Riflemen x 3 roles)*

    b. *5W continuous (anticipated average load)*

    c. *10W continuous (US Section Commander / UK Team Leader & 2IC also Norwegian Normal Soldier)*

    d. *20W continuous (US Squad Leader / Norwegian High Power Soldier)*

3. *A supplementary composite load comprising 10W background with superimposed 30W pulses (40W total) has been proposed with the pulse applied for 1 minute in each 30-minute period during discharge.*

4. *The power sources evaluated must be manworn / manportable therefore we need to limit the size and weight.*

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TEST VEHICLES & DATA

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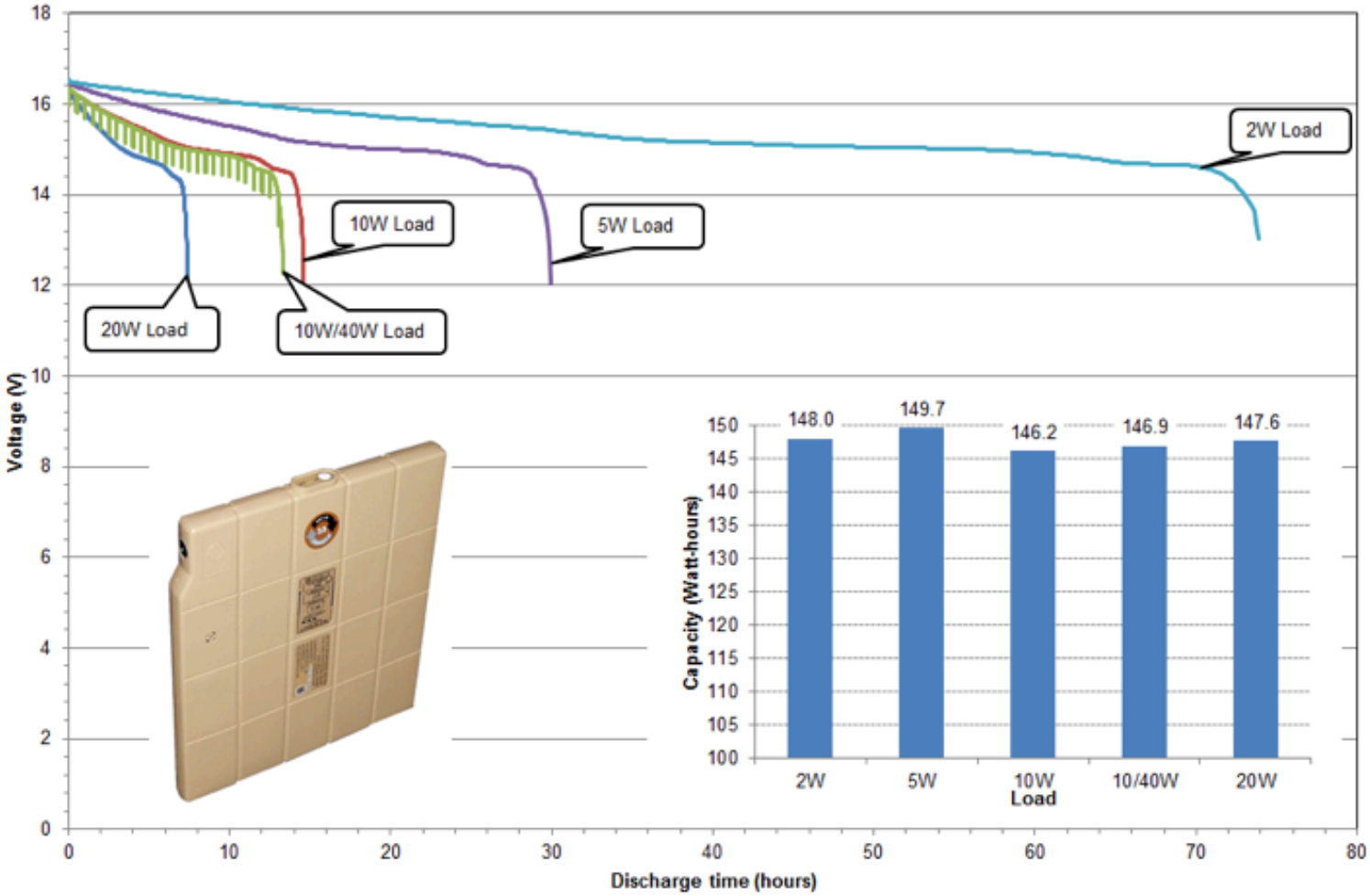
Conformal (Li-Ion Rechargeable)



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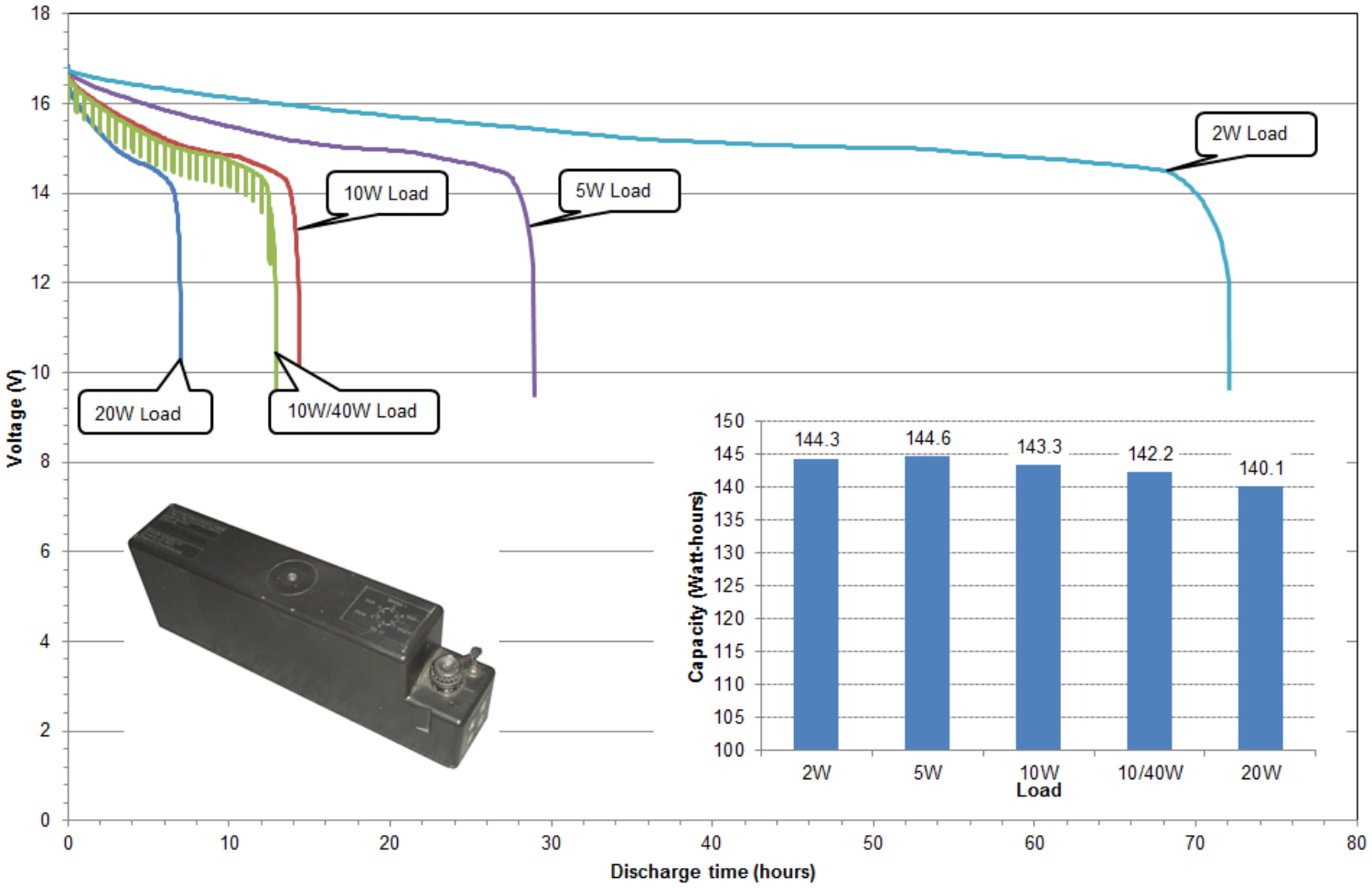
LI-145 (Li-Ion Rechargeable)



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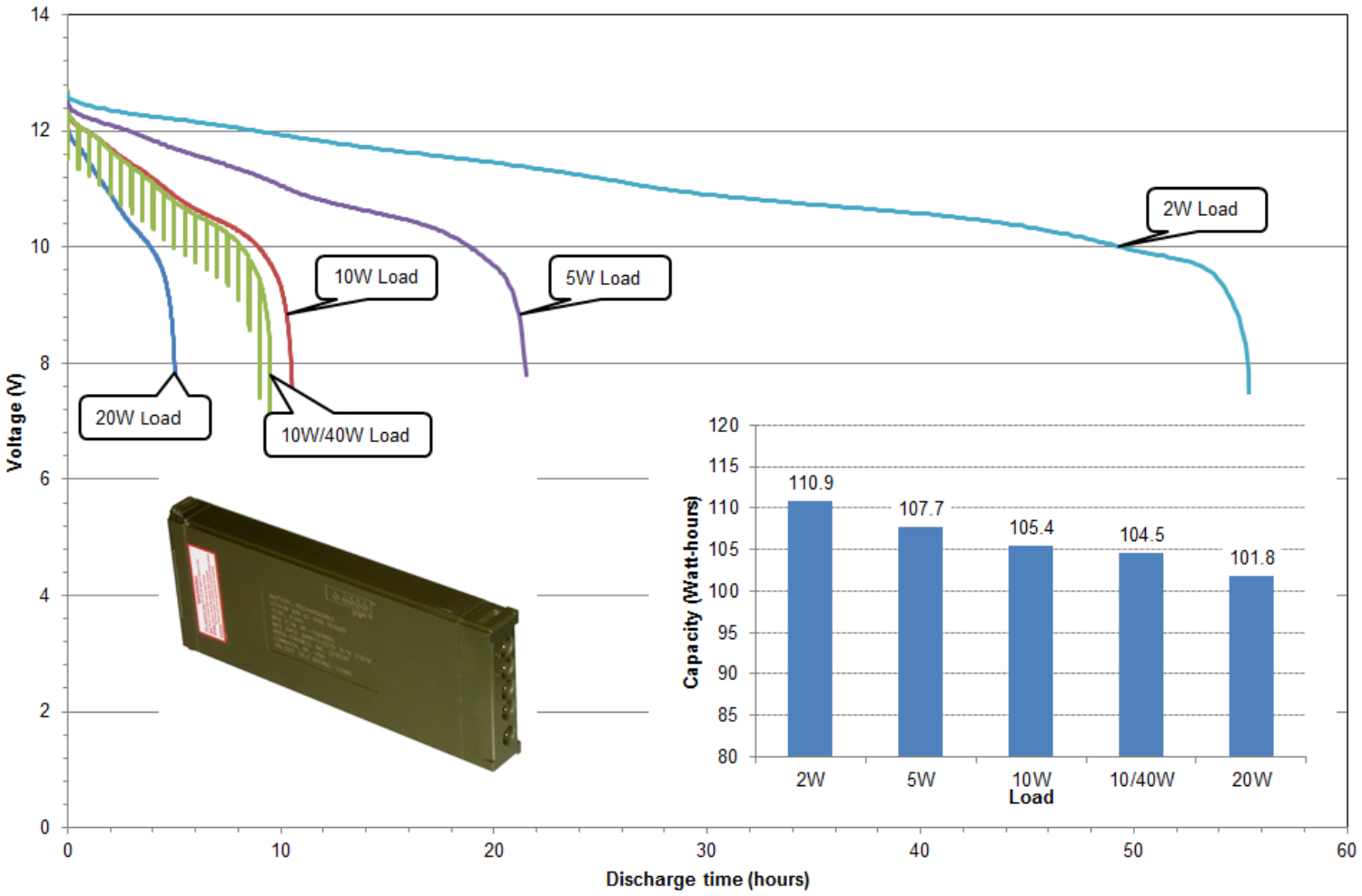
IDZ Full Size (Li-Ion Rechargeable)



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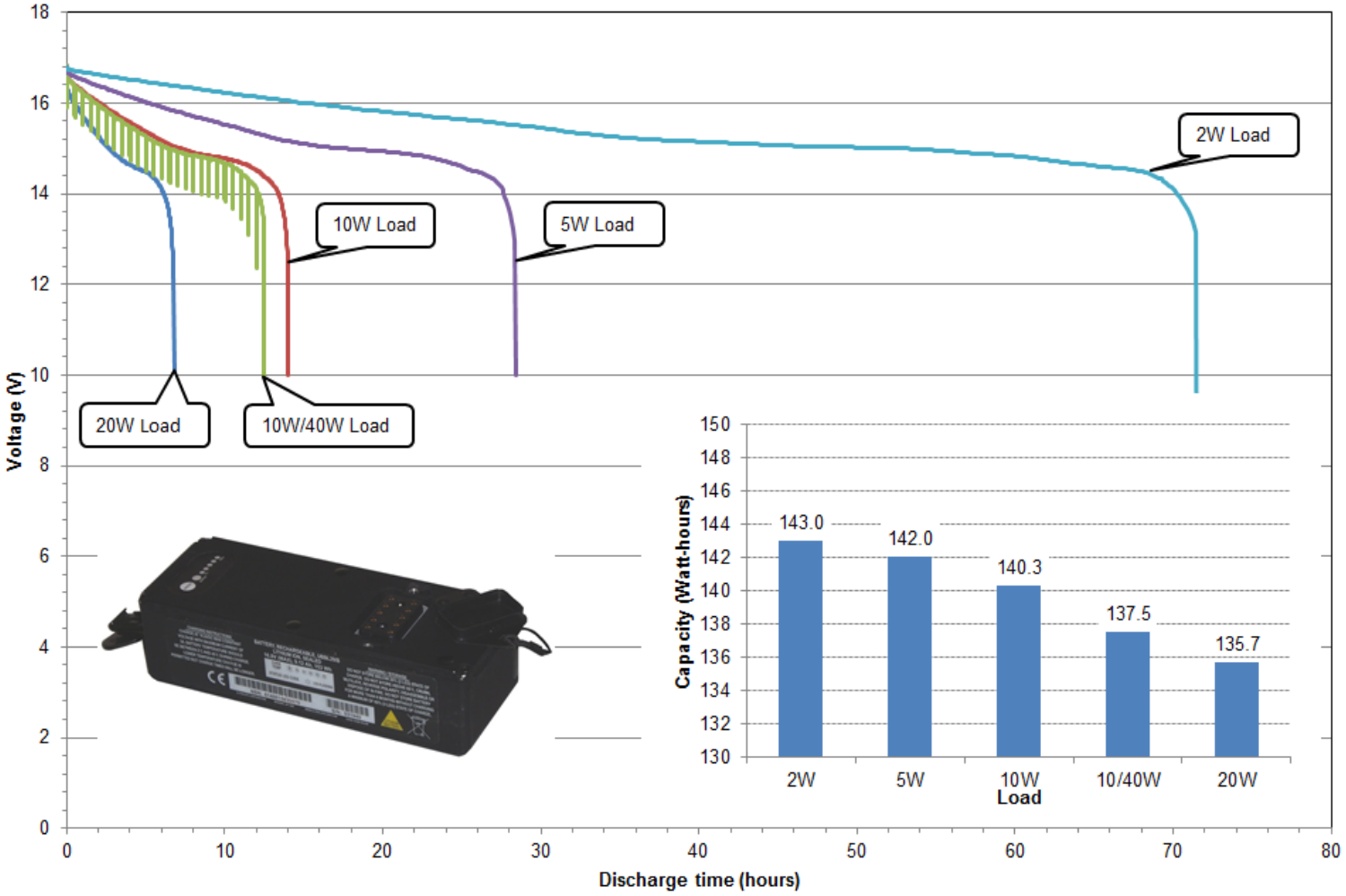
BOWMAN VHF (Li-Ion Rechargeable)



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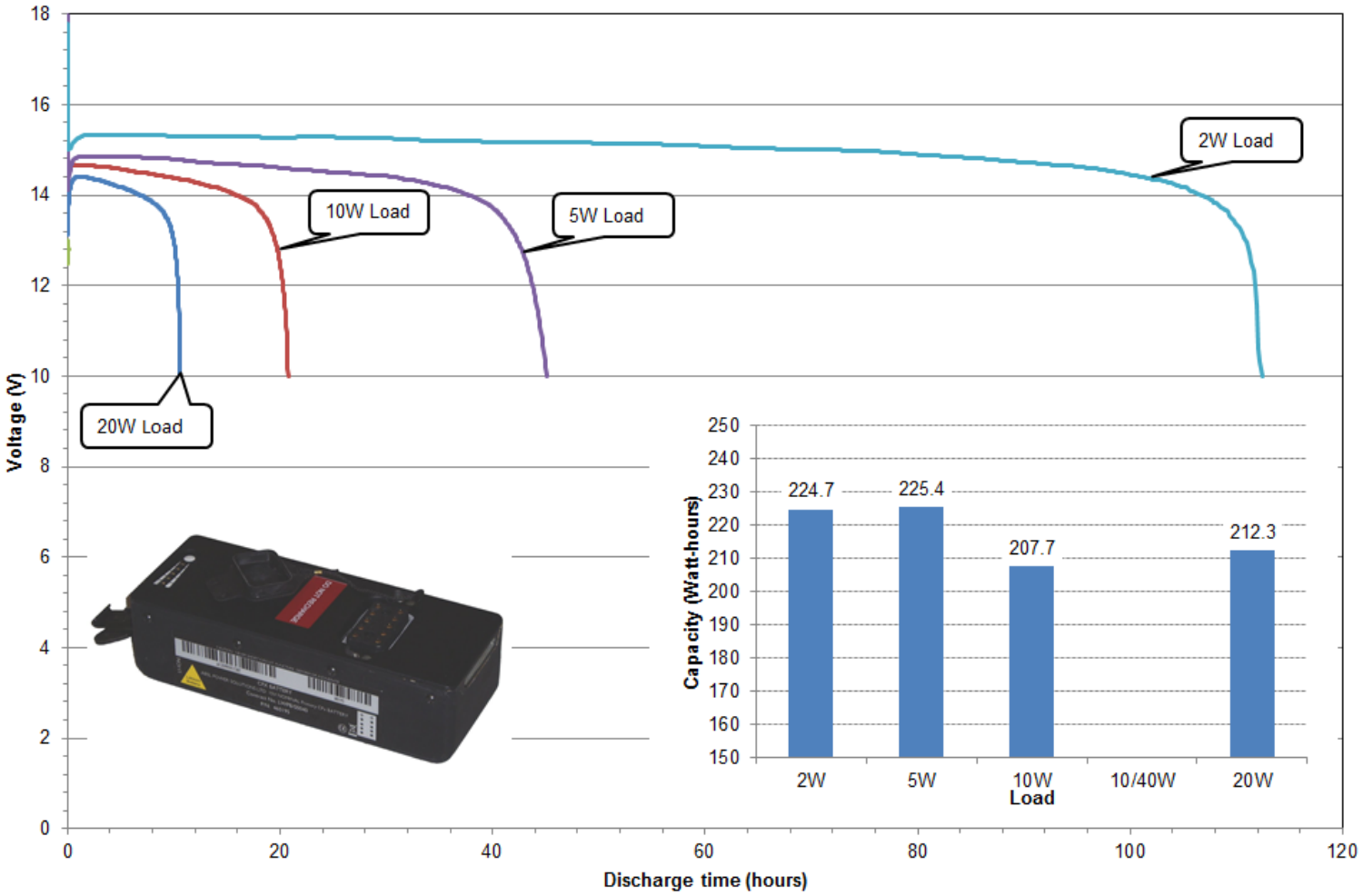
BOWMAN VHF (Li-CFx Non-rechargeable)



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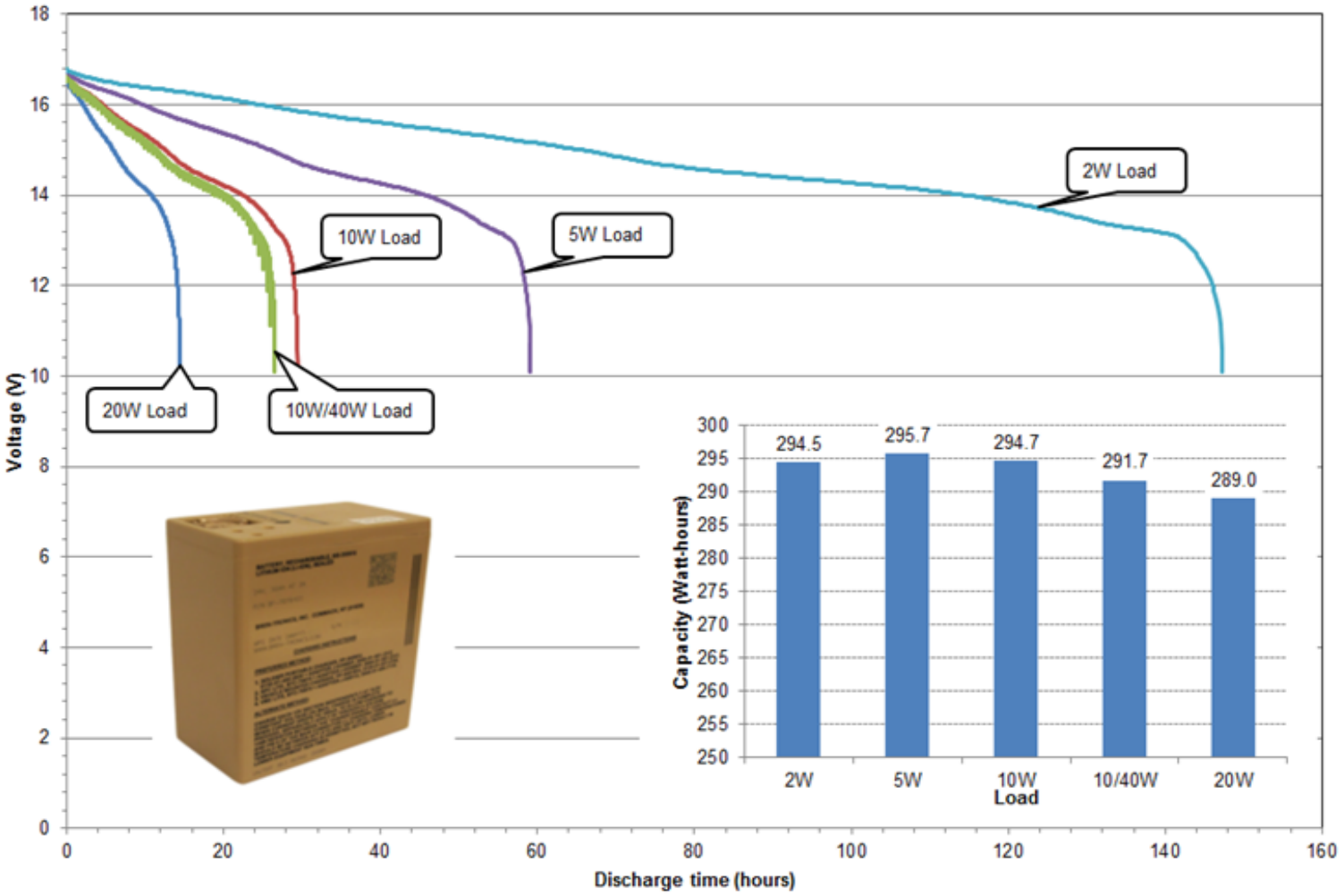
BB-2590/U (Li-Ion Rechargeable)



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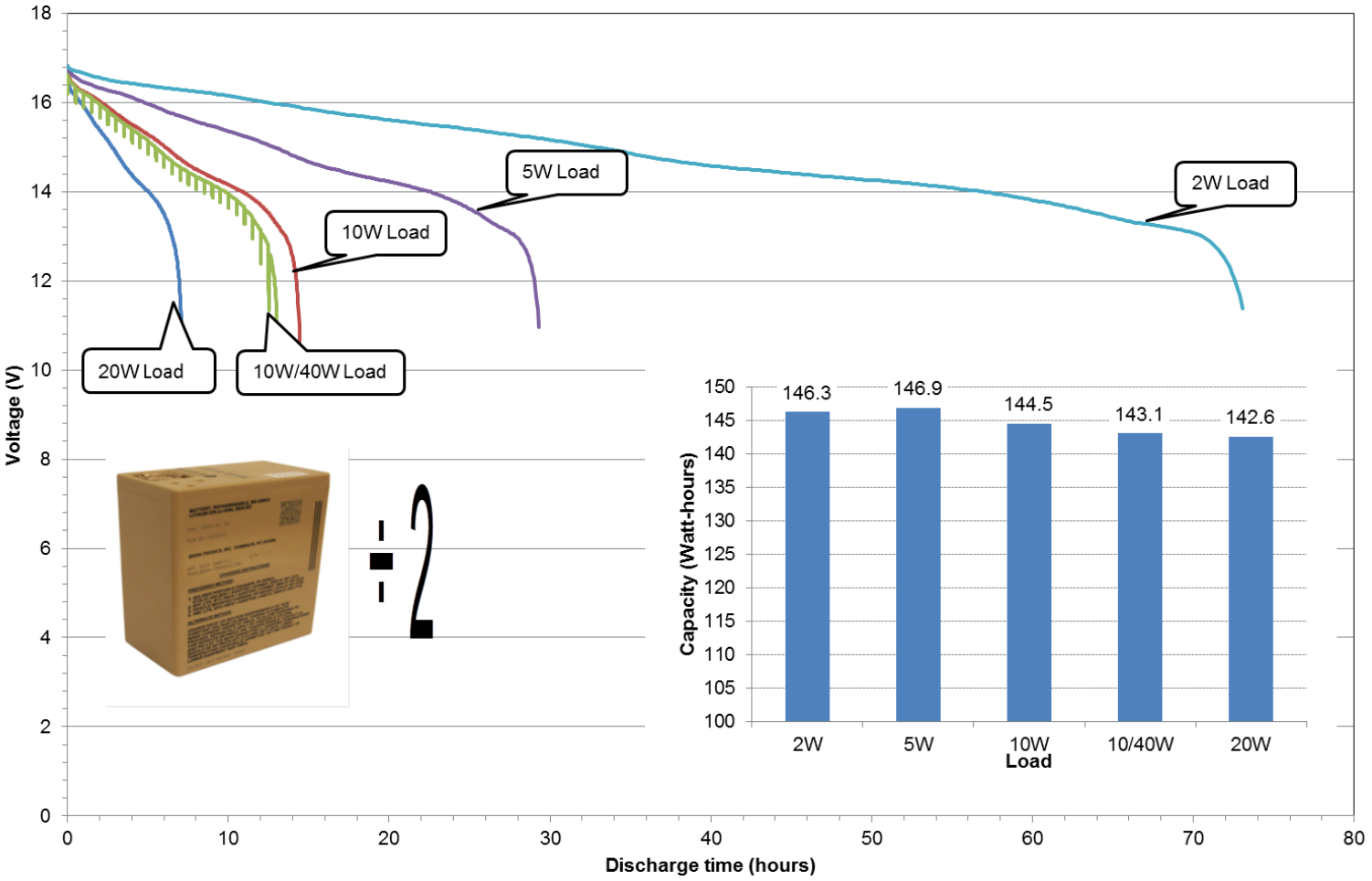
QQ Half BB-2590/U (Li-Ion Rechargeable)



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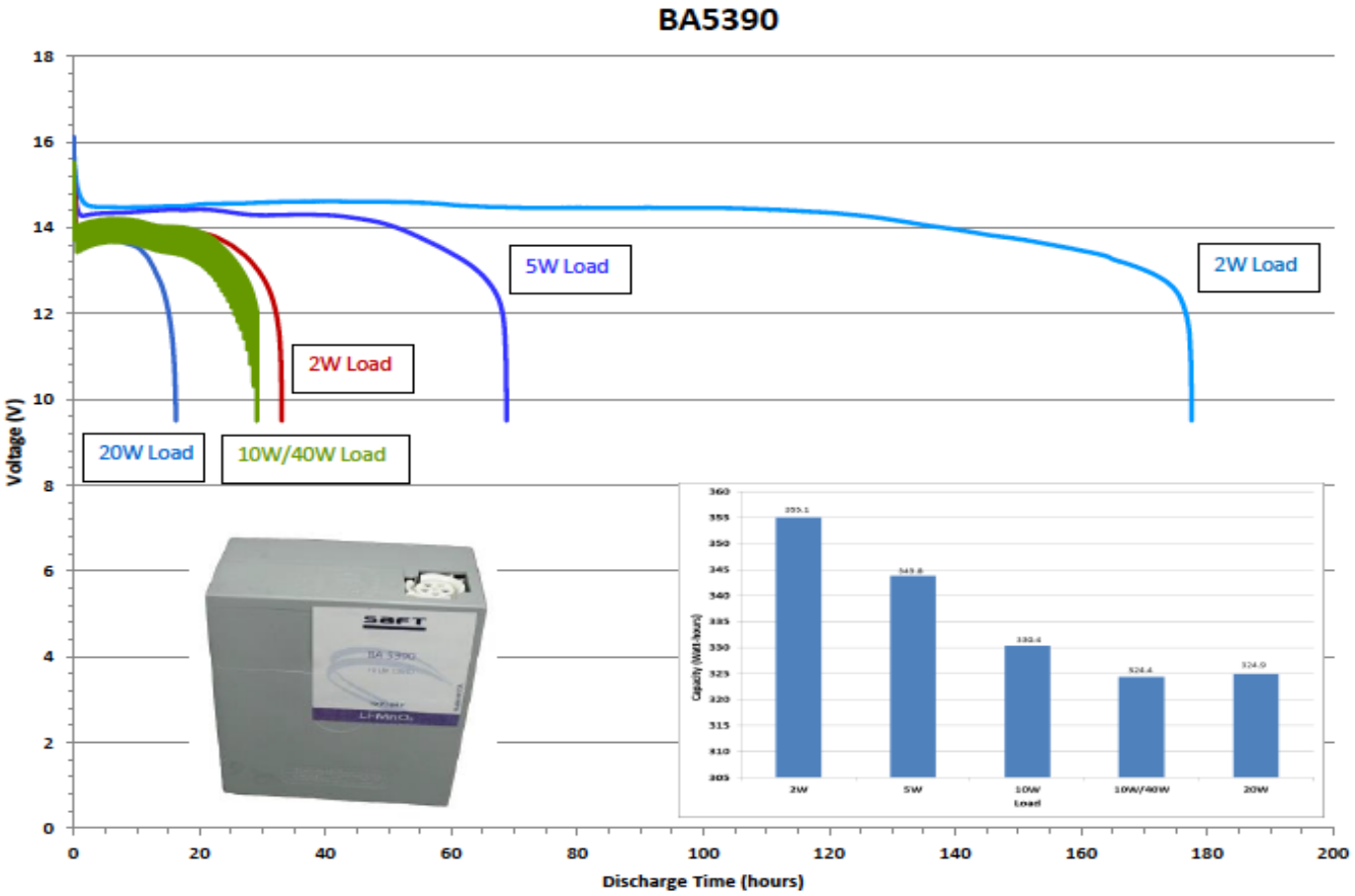
Li-MnO_2 BA-5390/u battery



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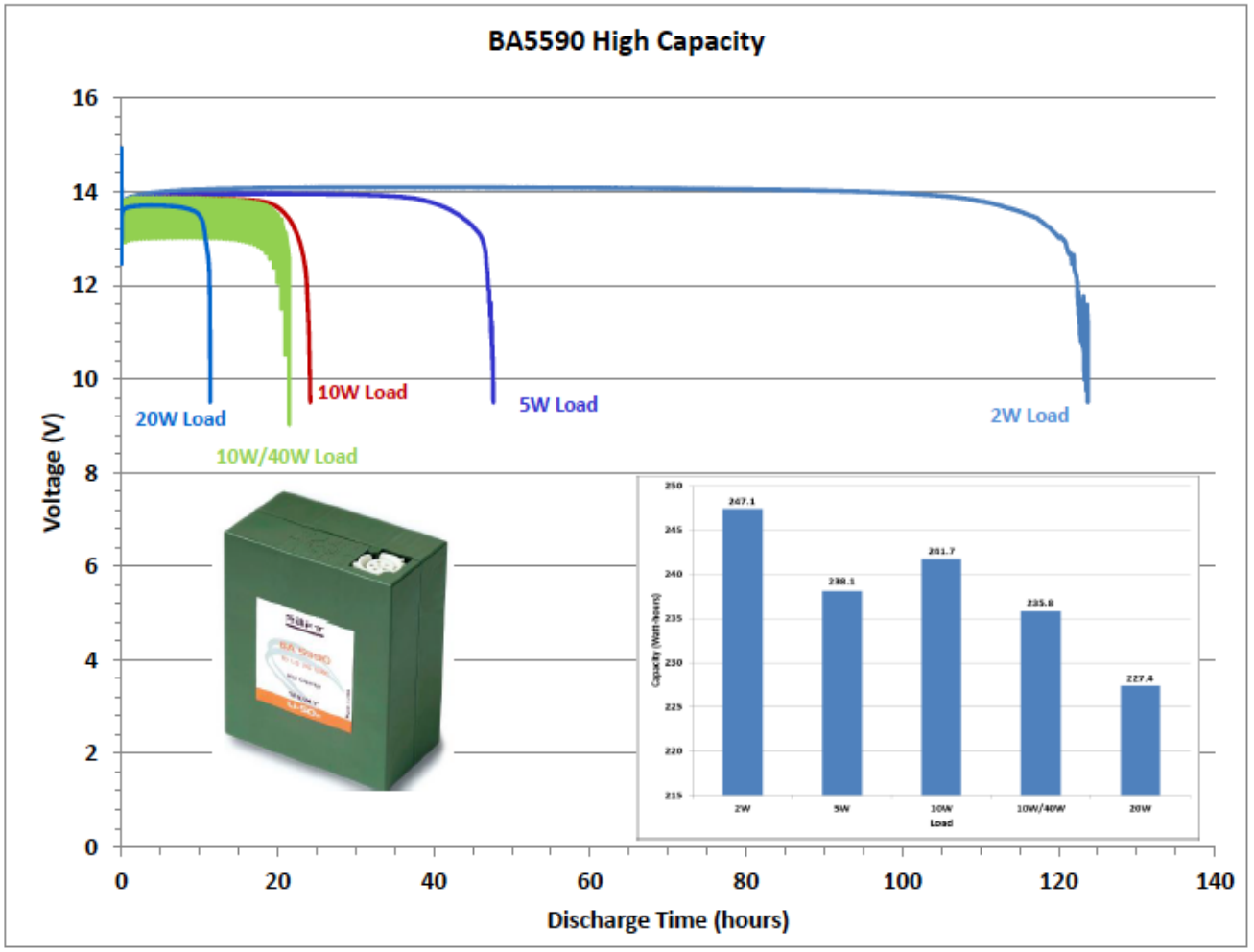
SAFT Li SO_2 BA5590 High Capacity



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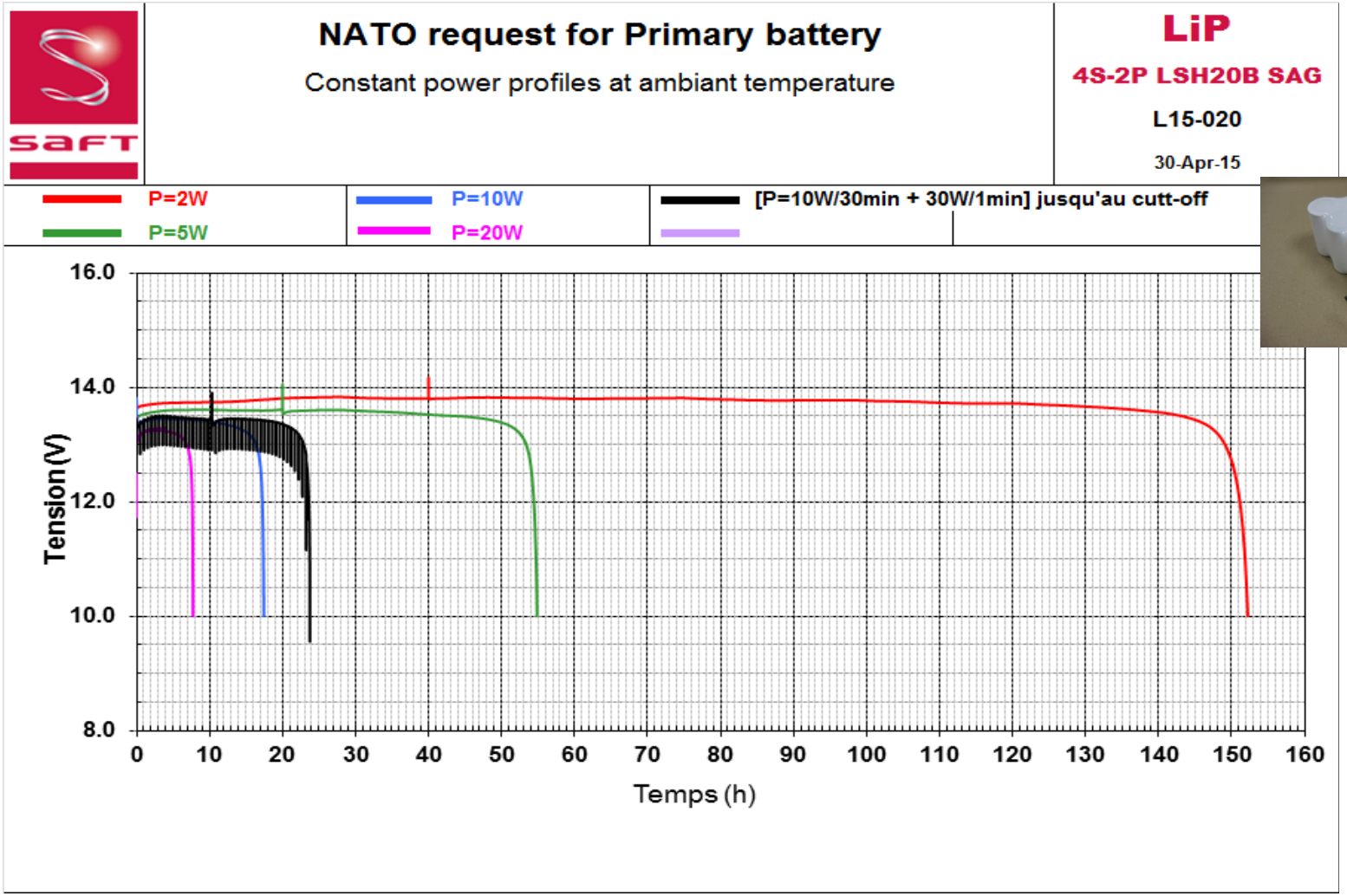
Lithium Thionyl Chloride - Special



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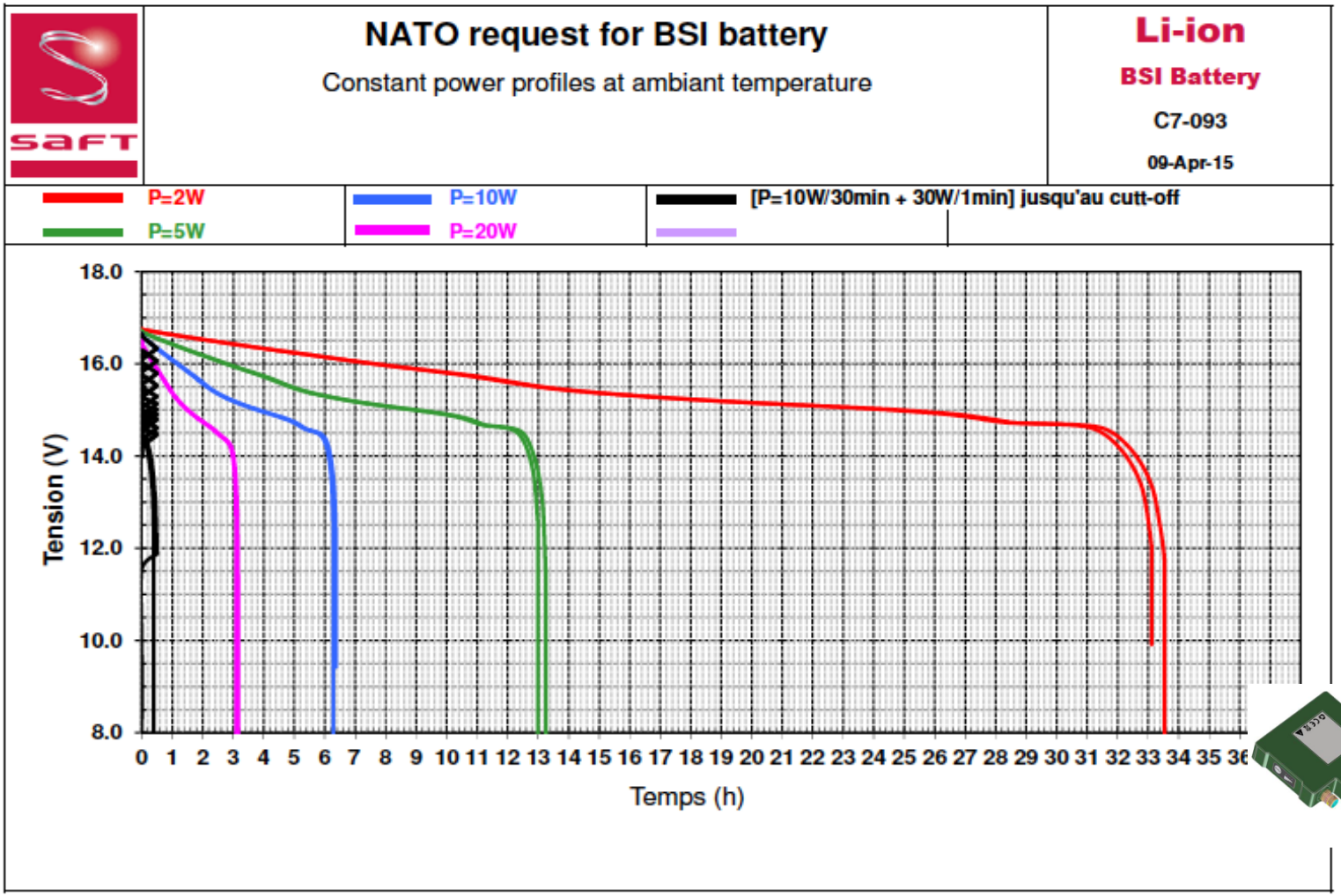
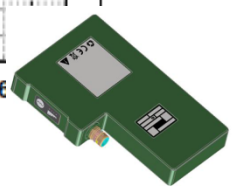
Felin Battery (Candidate)





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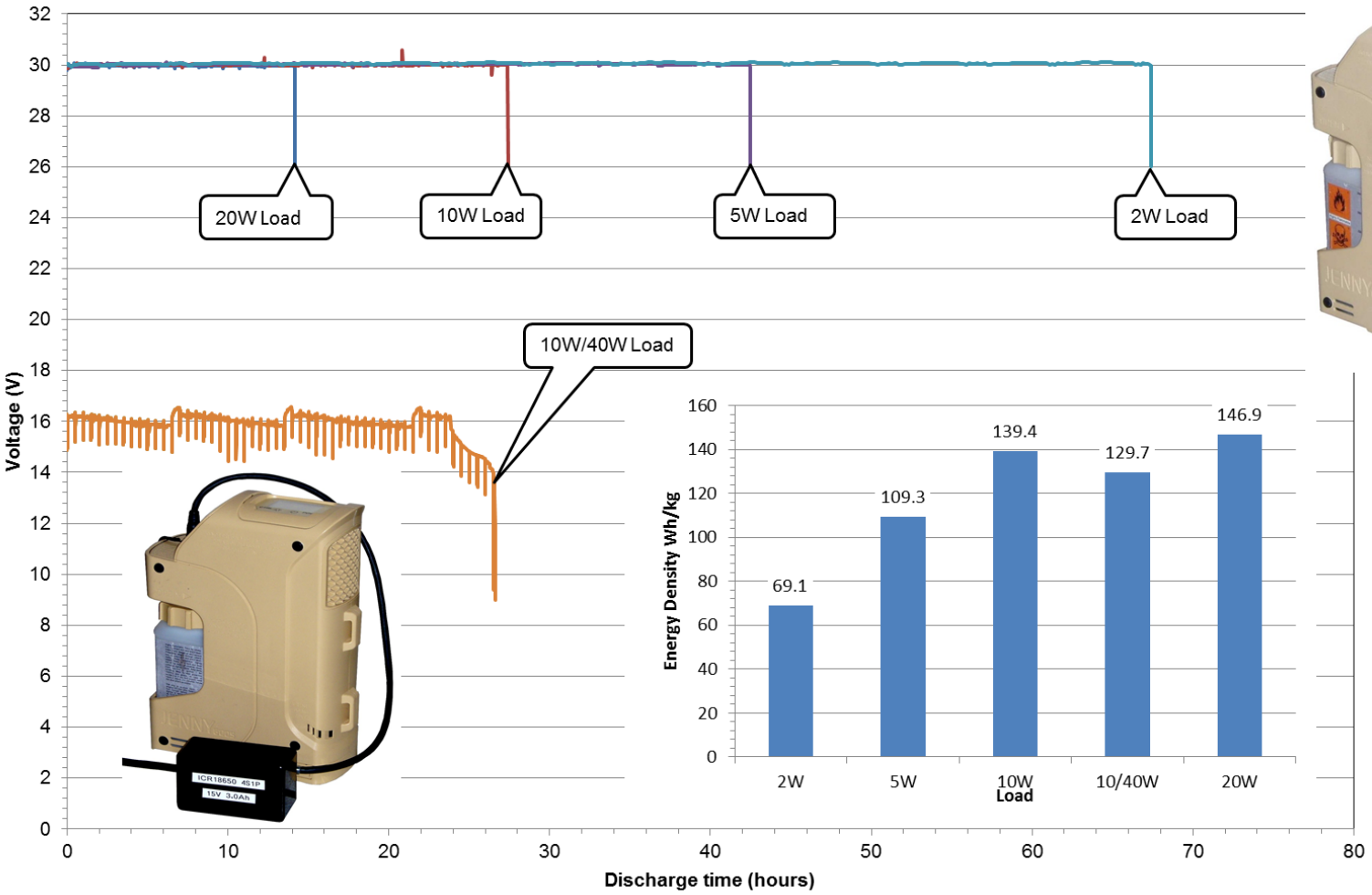
Jenny 600S assessment results – with and without Battery



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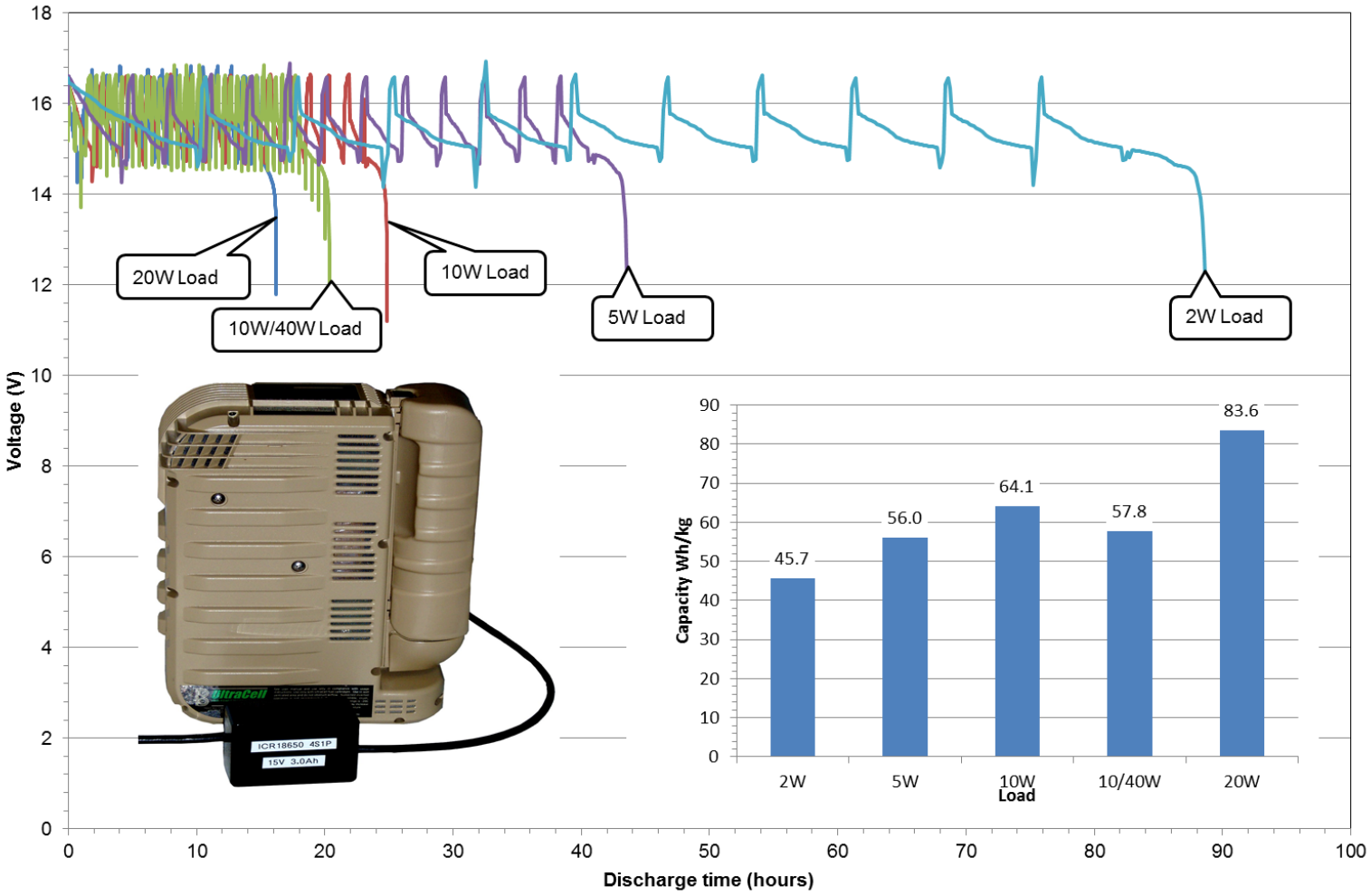
XX55 with 4S ICR18650Li-Ion pack (Hybrid)



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System run time at the designated loads

Battery Type	Chemistry	Discharge Time (h)					Impact of 20W on run time (%)
		2W (Rifleman Load)	5W (Average Load)	10W (Section Commander)	10/40W (Composite Load)	20W (Squad Leader)	
XX55 with 4S1P	Reformed Methanol Fuel Cell	88.58	43.49	24.88	20.39	16.23	18.3
BA 5390/U	Lithium Manganese Dioxide	177.50	68.70	33.00	29.00	16.10	9.1
BB-2590/U	Lithium-ion Rechargeable	147.25	59.14	29.44	26.51	14.43	9.8
Jenny 600S Standalone	Direct Methanol Fuel Cell	67.41	42.50	27.41	26.51	14.15	21.0
BA 5590 HC	Lithium Sulphur Dioxide	123.70	47.60	24.10	21.50	11.40	9.2
Bowman CFx	Lithium Carbon Monofluoride Non Rechargeable	112.39	45.08	20.77	N/A	10.62	9.4
BA 5590 B/U	Lithium Sulphur Dioxide	109.00	41.50	20.00	18.50	10.00	9.2
LIPS 12	Lithium-ion Rechargeable	82.79	35.92	18.54	16.85	9.30	11.2
4S2P - LSH20B-SAG	Lithium Thionyl Chloride	152.00	55.00	17.50	24.00	7.50	4.9
Conformal (CWB)	Lithium-ion Rechargeable	73.91	29.91	14.61	13.33	7.36	10.0
QQHalf BB-2590/U	Lithium-ion Rechargeable	73.13	29.38	14.45	13.01	7.13	9.7
Li 145	Lithium-ion Rechargeable	72.18	28.94	14.34	12.93	7.01	9.7
Bowman Li-ion	Lithium-ion Rechargeable	71.51	28.40	14.03	12.50	6.79	9.5
QQ4S3PTDP	Lithium-ion Rechargeable	69.08	27.49	13.51	12.01	6.71	9.7
BB-390B/U	Nickel Metal Hydride	62.24	25.24	12.38	11.00	6.13	9.8
IDZ Full Size	Lithium-ion Rechargeable	55.47	21.49	10.51	9.50	4.99	9.0
LIPS 14	Lithium-ion Rechargeable	50.91	19.71	9.68	9.00	4.96	9.7
IDZ 2/3	Lithium-ion Rechargeable	36.52	14.24	7.04	6.01	3.41	9.3
Felin	Lithium-ion Rechargeable	33.50	13.30	6.30	N/A	3.10	9.3

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System Quantity, Weight and Volume for 72h Mission

Battery id		QTY for Mission Duration 72h					Weight for Mission Duration 72h					Volume for Mission Duration 72h				
		2W	5W	10W	10/40W	20W	2W	5W	10W	10/40W	20W	2W	5W	10W	10/40W	20W
Jenny 600S Standalone	End Weight	2	2	3	3	6	2.04	1.87	1.97	2.32	2.40	3.78	3.78	4.38	4.56	6.16
Jenny 600S Standalone	Start Weight	2	2	3	3	6	2.34	2.34	2.71	3.01	3.83	3.78	3.78	4.38	4.56	6.16
XX55 with 4S1P	End Weight	1	2	3	4	5	4.18	4.42	4.48	4.82	5.03	7.26	8.40	9.55	10.69	11.84
Bowman CFx		1	2	4	N/A	7	0.86	1.72	3.44	N/A	6.02	0.66	1.32	2.64	N/A	4.62
BB-2590/U		1	2	3	3	5	1.39	2.78	4.17	4.17	6.95	0.88	1.76	2.65	2.65	4.41
XX55 with 4S1P	Start Weight	1	2	3	4	5	4.54	5.16	5.78	6.40	7.02	7.26	8.40	9.55	10.69	11.84
BA 5390/U		1	2	3	3	5	1.41	2.82	4.23	4.23	7.05	0.88	1.76	2.65	2.65	4.41
BA 5590 HC		1	2	3	4	7	1.02	2.04	3.06	4.08	7.14	0.88	1.77	2.65	3.53	6.18
QQHalf BB-2590/U		1	3	5	6	11	0.70	2.09	3.48	4.17	7.65	0.44	1.32	2.20	2.65	4.85
IDZ Full Size		2	4	7	8	15	1.08	2.16	3.78	4.32	8.1	0.70	1.40	2.45	2.81	5.26
BA 5590 B/U		1	2	4	4	8	1.02	2.04	4.08	4.08	8.16	0.88	1.77	3.53	3.53	7.07
QQ4S3PTDP		2	3	6	6	11	1.5	2.25	4.5	4.5	8.25	1.20	1.80	3.60	3.60	6.60
IDZ 2/3		2	6	11	12	22	0.76	2.28	4.18	4.56	8.36	0.51	1.53	2.81	3.06	5.61
4S2P - LSH20B-SAG		1	2	5	3	10	0.84	1.68	4.2	2.52	8.4	0.58	1.15	2.88	1.73	5.77
LIPS 14		2	4	8	8	15	1.24	2.48	4.96	4.96	9.3	0.72	1.44	2.89	2.89	5.42
Li 145		1	3	6	6	11	0.98	2.94	5.88	5.88	10.78	0.65	1.96	3.92	3.92	7.18
Conformal (CWB)		1	3	5	6	10	1.19	3.57	5.95	7.14	11.9	1.42	4.25	7.08	8.50	14.16
LIPS 12		1	3	4	5	8	1.565	4.695	6.26	7.825	12.52	1.03	3.10	4.13	5.17	8.27
Bowman Li-ion		2	3	6	6	11	2.472	3.708	7.416	7.416	13.596	1.32	1.98	3.96	3.96	7.26
Felin		3	6	12	N/A	24	1.95	3.9	7.8	N/A	15.6	1.33	2.66	5.32	N/A	10.64
BB-390B/U		2	3	6	7	12	3.636	5.454	10.908	12.726	21.816	1.76	2.65	5.29	6.17	10.58

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Squad Stats based on various single source batteries for 72h

US (NSRDEC)	Squad Stats for 72h mission (Primary)			Each Role			Squad Compliment		
BA 5590 HC	Role	#	Power Source	Qty	Weight	Volume	Qty	Weight (Kg)	Volume (L)
	Rifleman (10W)	6	BA 5590 HC	3	3.06	2.65	18	18.36	15.90
	Team Leader (10W)	2	BA 5590 HC	3	3.06	2.65	6	6.12	5.30
	Squad Leader (20W)	1	BA 5590 HC	7	7.14	6.18	7	7.14	6.18
	Total	9					**31**	**31.62**	**27.38**
						Per Role	3.44	3.51	3.04

US (NSRDEC)	Squad Stats for 72h mission (Rechargeables)			Each Role			Squad Compliment		
BB-2590/U	Role	#	Power Source	Qty	Weight	Volume	Qty	Weight (Kg)	Volume (L)
	Rifleman (10W)	6	BB-2590/U	3	4.17	2.65	18	25.02	15.87
	Team Leader (10W)	2	BB-2590/U	3	4.17	2.65	6	8.34	5.29
	Squad Leader (20W)	1	BB-2590/U	5	6.95	4.41	5	6.95	4.41
	Total	9					**29**	**40.31**	**25.57**
						Per Role	3.22	4.48	2.84

US	Squad Stats for 72h mission (Rechargeables)			Each Role			Squad Compliment		
IDZ Full Size	Role	#	Power Source	Qty	Weight	Volume	Qty	Weight (Kg)	Volume (L)
	Rifleman (10W)	6	IDZ Full Size	7	3.78	2.45	42	22.68	14.73
	Team Leader (10W)	2	IDZ Full Size	7	3.78	2.45	14	7.56	4.91
	Squad Leader (20W)	1	IDZ Full Size	15	8.1	5.26	15	8.1	5.26
	Total	9					**71**	**38.34**	**24.90**
						Per Role	7.89	4.26	2.77

US	Squad Stats for 72h mission (Rechargeables)			Each Role			Squad Compliment		
Conformal (CWB)	Role	#	Power Source	Qty	Weight	Volume	Qty	Weight (Kg)	Volume (L)
	Rifleman (10W)	6	Conformal (CWB)	5	5.95	7.08	30	35.7	42.48
	Team Leader (10W)	2	Conformal (CWB)	5	5.95	7.08	10	11.9	14.16
	Squad Leader (20W)	1	Conformal (CWB)	10	11.9	14.16	10	11.9	14.16
	Total	9					**50**	**59.5**	**70.81**
						Per Role	5.56	6.61	7.87

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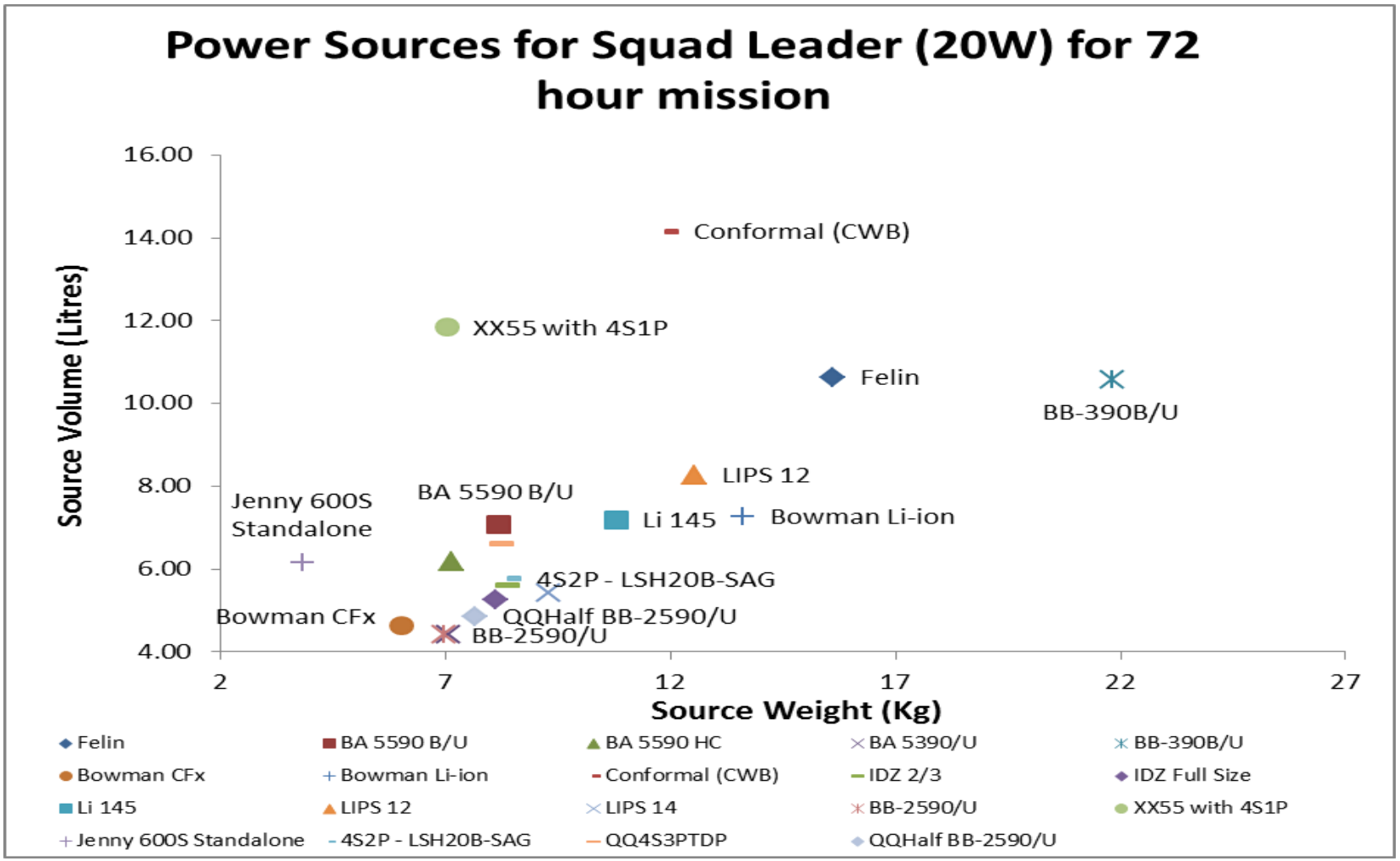
Relative position of the batteries tested – one example



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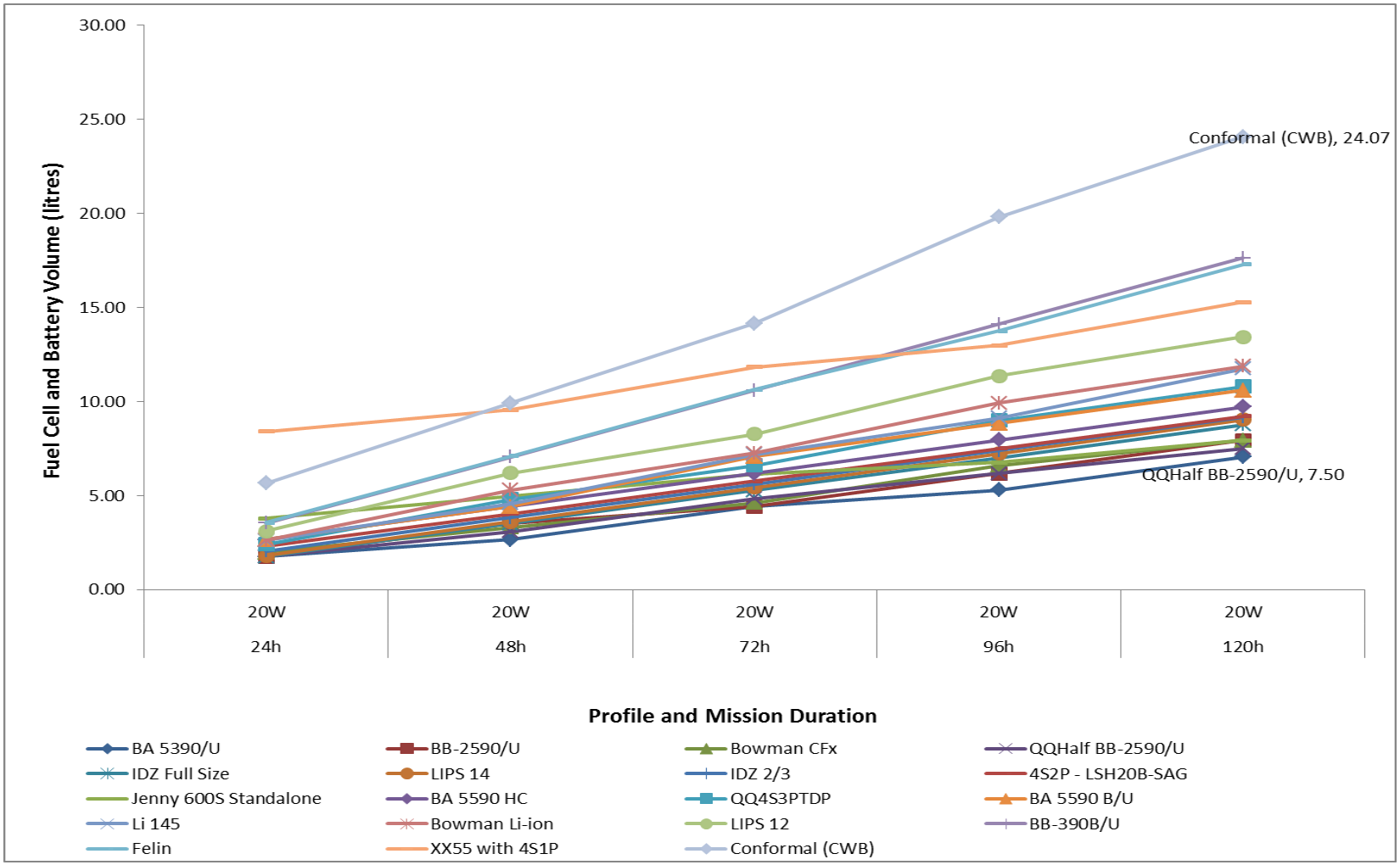
Volume of Batteries/Fuel Cells for the Mission @ 20W



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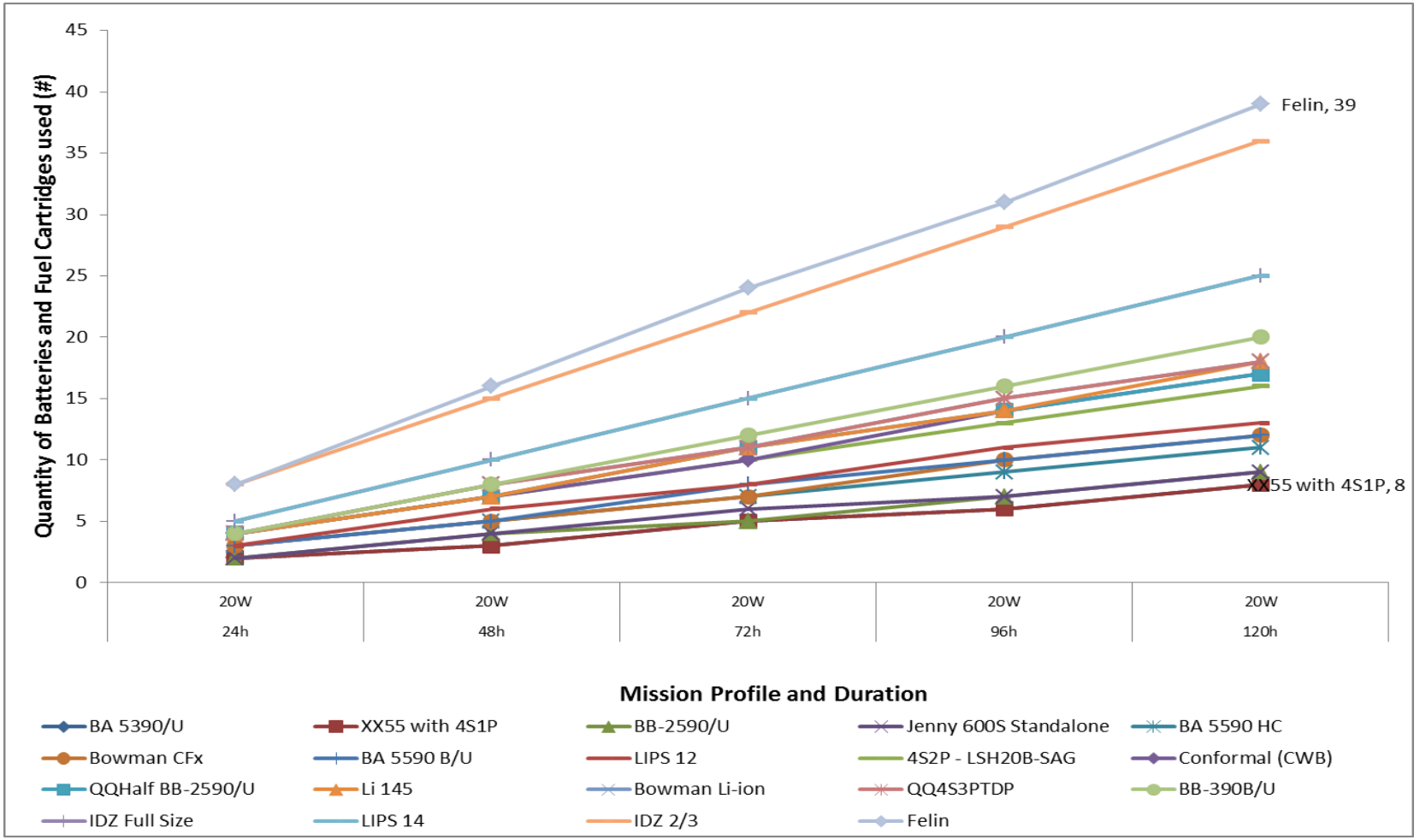
Quantity of Batteries/Fuel Cells for the Mission @ 20W



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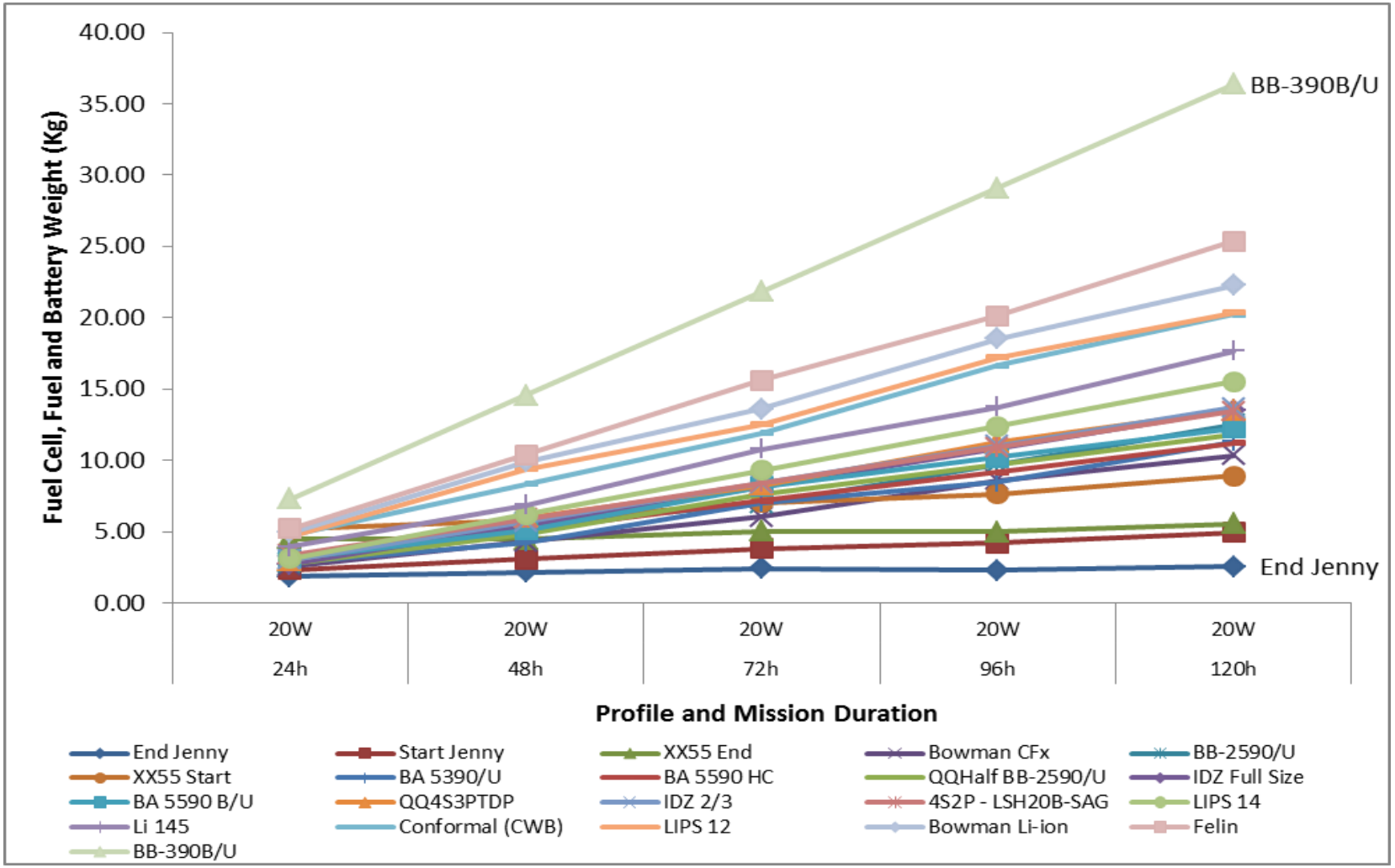
Weight of Batteries/Fuel Cells for the Mission @ 20W



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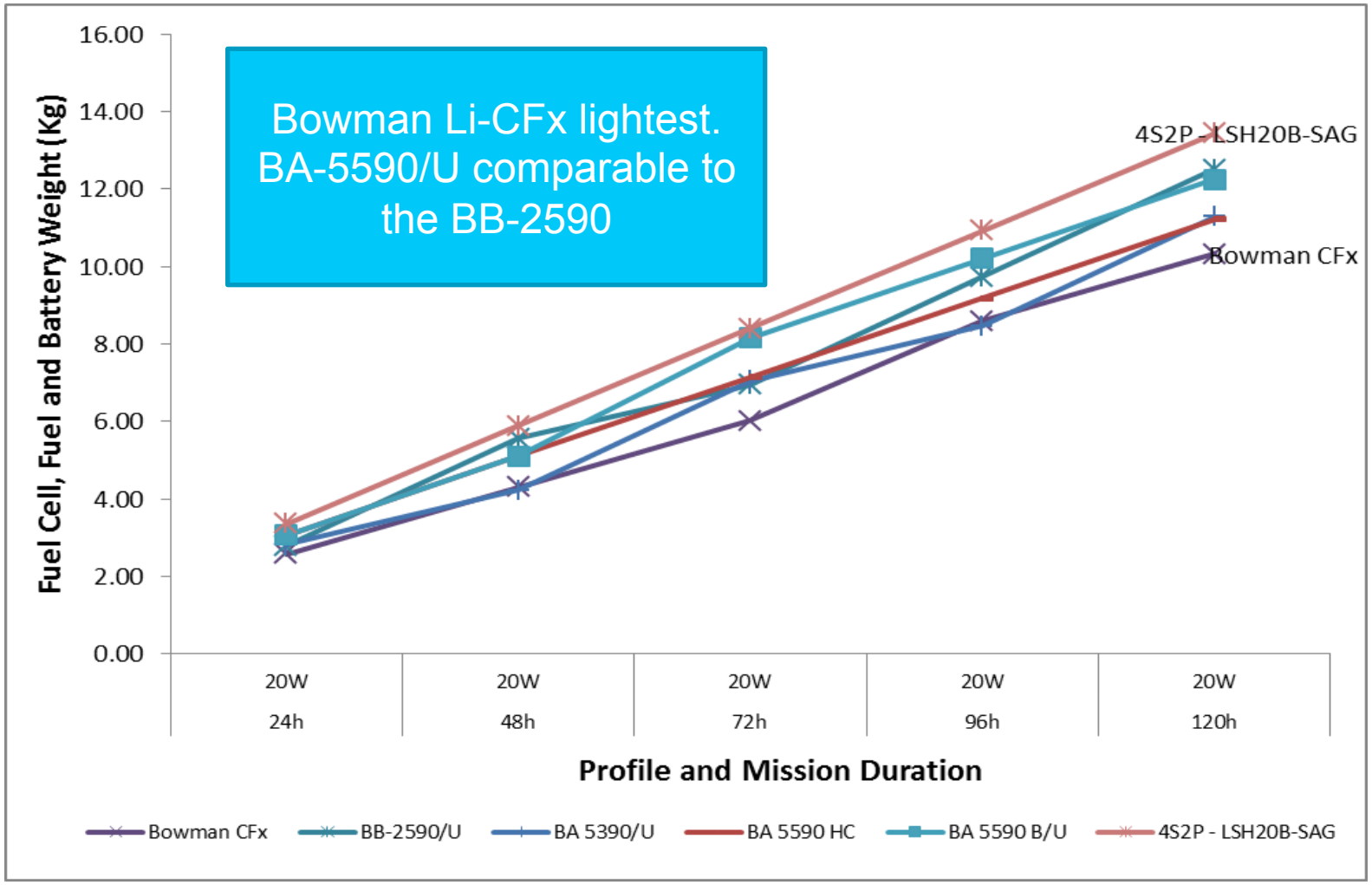
Weight Comparison for a range of primary batteries with the BB-2590



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US Squad Stats based on NSRDEC - Primary V Secondary

US (NSRDEC)	Squad Stats for 72h mission (Primary)			Each Role			Squad Compliment		
BA 5590 HC	Role	#	Power Source	Qty	Weight	Volume	Qty	Weight (Kg)	Volume (L)
	Rifleman (10W)	6	BA 5590 HC	3	3.06	2.65	18	18.36	15.90
	Team Leader (10W)	2	BA 5590 HC	3	3.06	2.65	6	6.12	5.30
	Squad Leader (20W)	1	BA 5590 HC	7	7.14	6.18	7	7.14	6.18
	Total	9					**31**	**31.62**	**27.38**
						Per Role	3.44	3.51	3.04

US (NSRDEC)	Squad Stats for 72h mission (Rechargeables)			Each Role			Squad Compliment		
BB-2590/U	Role	#	Power Source	Qty	Weight	Volume	Qty	Weight (Kg)	Volume (L)
	Rifleman (10W)	6	BB-2590/U	3	4.17	2.65	18	25.02	15.87
	Team Leader (10W)	2	BB-2590/U	3	4.17	2.65	6	8.34	5.29
	Squad Leader (20W)	1	BB-2590/U	5	6.95	4.41	5	6.95	4.41
	Total	9					**29**	**40.31**	**25.57**
						Per Role	3.22	4.48	2.84

At the 20W load/72h - comparison between the XX90 footprint showed that the primary system had an overall weight saving of 8.69Kg (27%) with a slightly larger volume (1.81 litres).

However, in remote DSS operations Primaries present a greater burden to the supply chain and cannot be re-charged.

For the purposes of assessing the DSS Weight Burden in terms of a centralised power source work on primary battery's ceased, at this point. Not least because of disposal…….

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Rechargeable Systems

NORTH ATLANTIC TREATY ORGANIZATION

SCIENCE AND TECHNOLOGY ORGANIZATION

AC/323(SET-173)TR/559

STO TECHNICAL REPORT

TR-SET-173-Part-I

Fuel Cells and Other Emerging Manportable Power Technologies for the NATO Warfighter – Part I: Power Sources for Manportable/ Manwearable Applications

(Piles à combustible et autres technologies portatives d'alimentation en énergie pour les combattants de l'OTAN – Partie I : Sources d'alimentation pour les applications transportables/portables par l'homme)

This is the Final Report of SET-173 "Fuel Cells and Other Emerging Manportable Power Technologies for the NATO Warfighter" on the use of fuel cells in manwearable and manportable applications.

Published October 2014

Distribution and Availability on Back Cover

Rechargeable Systems

BB-2590, Conformal IDZ

Assess Detailed results
Quantity
Weight
Volume

How do they compare.

Fuel Cells

Limited Candidates

Asses results
Fuel Cartridges (Empty/Full)
Hybridisation
Quantity
Weight
Volume

How do they compare

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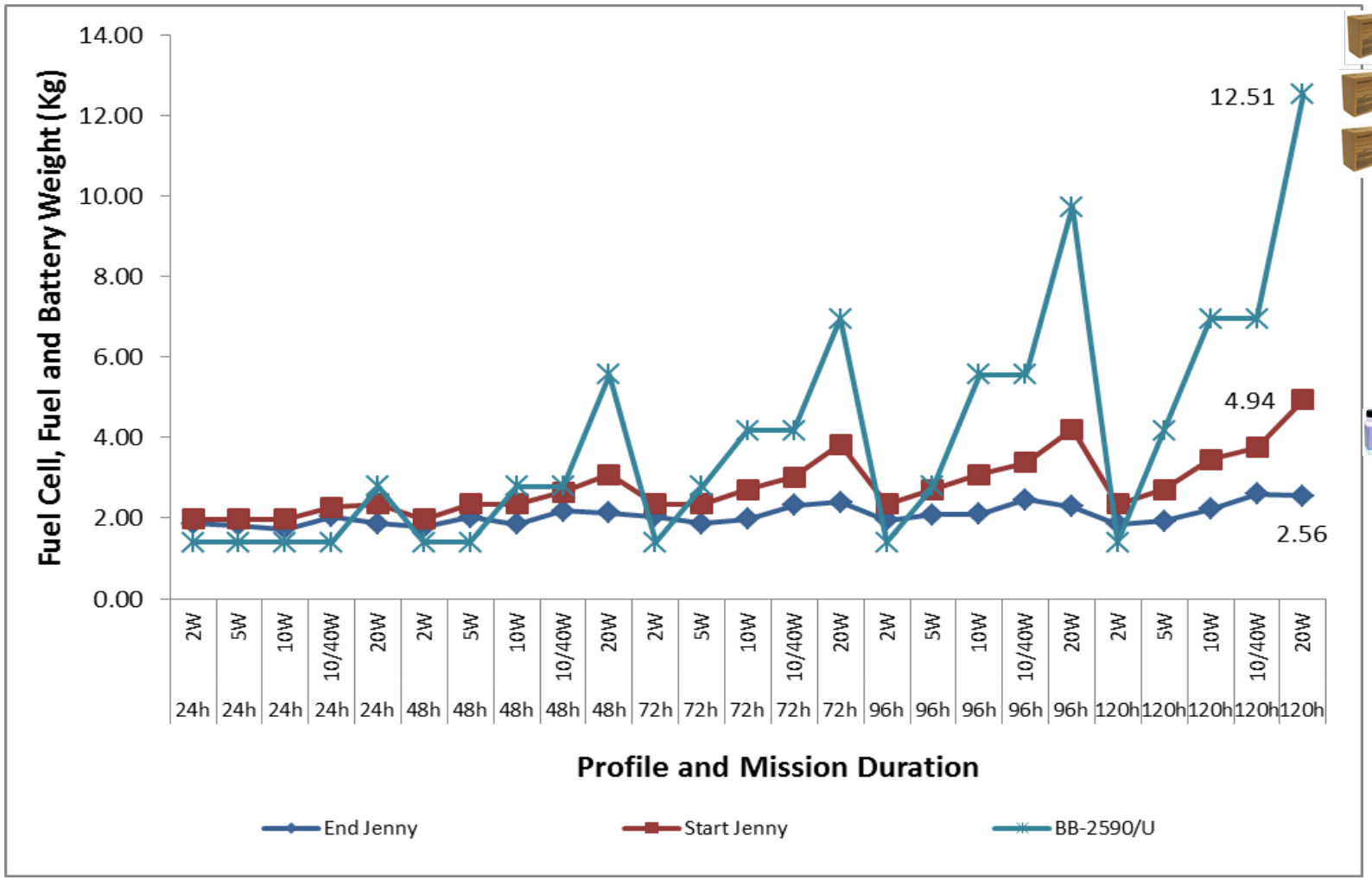
Weight of BB-2590 V Jenny 600 DMFC



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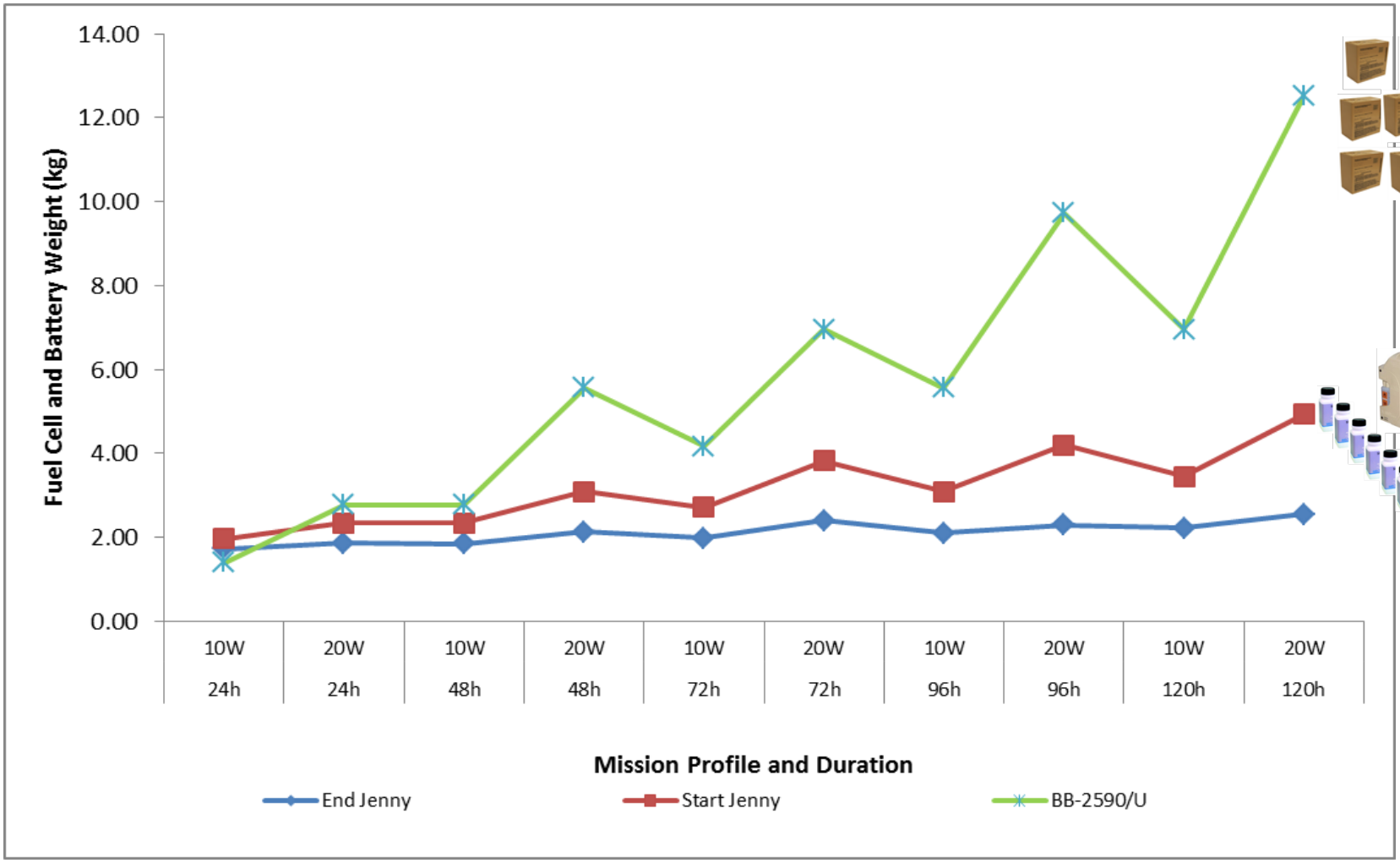
Weight of BB-2590 V Jenny 600 DMFC @ NSRDEC Loads



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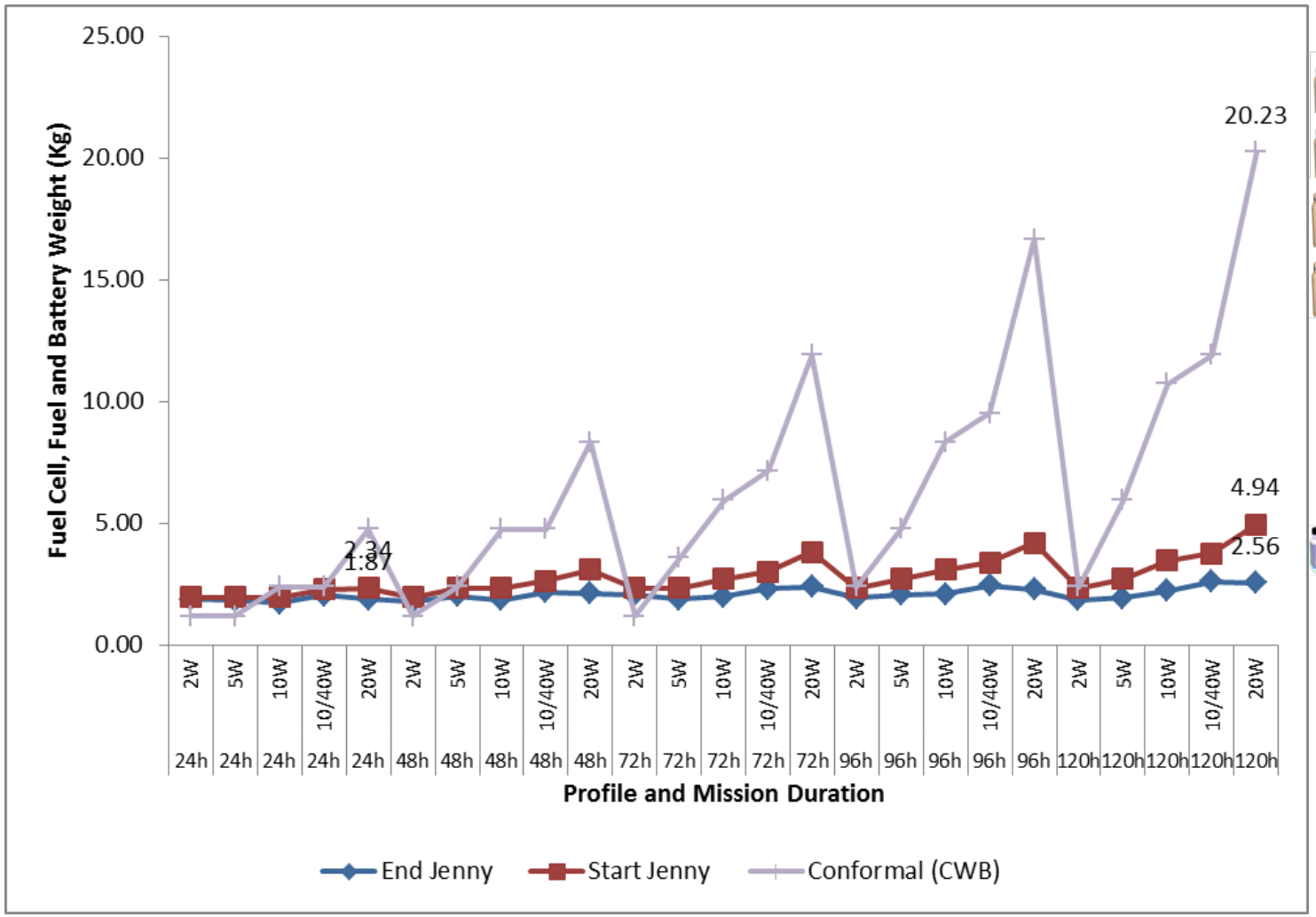
Weight of Conformal V Jenny 600 DMFC (Start & End)



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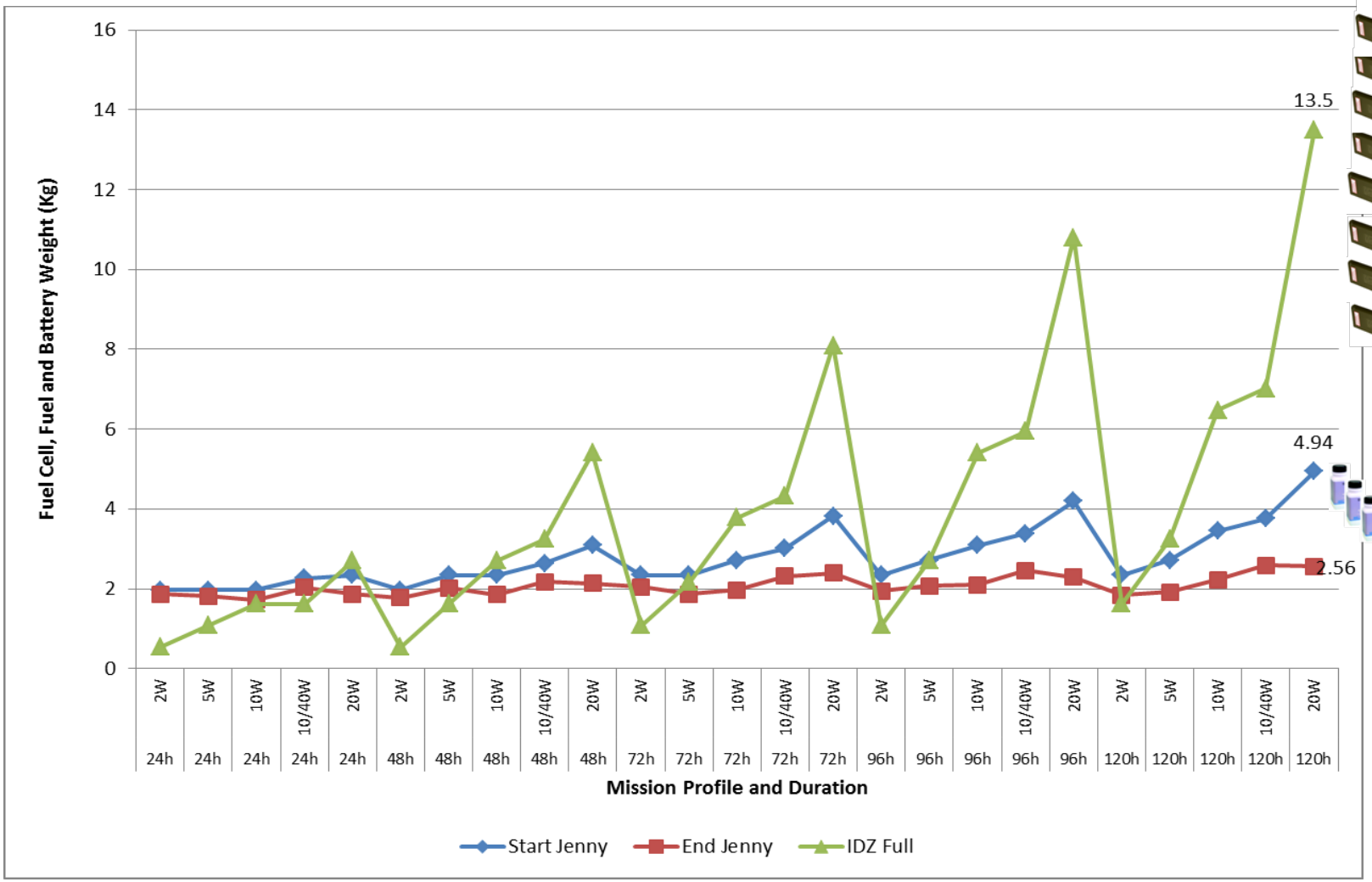
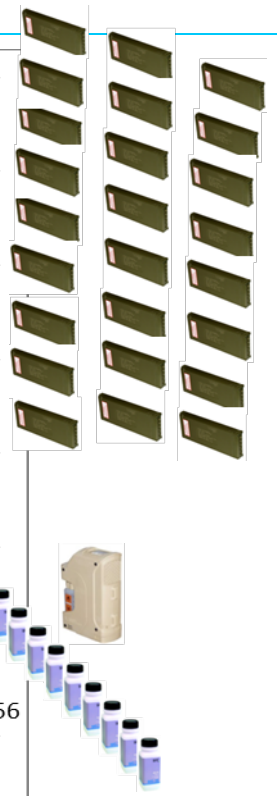
Weight of IDZ V Jenny 600 DMFC (Start & End)





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Prioritised results based on 20W for 72 hour mission Smallest to Largest (Rechargeable Systems)

Mission Weight
End Jenny
Start Jenny
XX55 End
BB-2590/U
XX55 Start
QQHalf BB-2590/U
IDZ Full Size
QQ4S3PTDP
IDZ 2/3
LIPS 14
Li 145
Conformal (CWB)
LIPS 12
Bowman Li-ion
Felin
BB-390B/U

Mission QTY
XX55 with 4S1P
BB-2590/U
Jenny 600S Standalone
LIPS 12
Conformal (CWB)
QQHalf BB-2590/U
Li 145
Bowman Li-ion
QQ4S3PTDP
BB-390B/U
IDZ Full Size
LIPS 14
IDZ 2/3
Felin

Mission Volume
BB-2590/U
QQHalf BB-2590/U
IDZ Full Size
LIPS 14
IDZ 2/3
Jenny 600S Standalone
QQ4S3PTDP
Li 145
Bowman Li-ion
LIPS 12
BB-390B/U
Felin
XX55 with 4S1P
Conformal (CWB)

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Programme Summary

NORTH ATLANTIC TREATY ORGANIZATION

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Published October 2014

Distribution and Availability on Back Cover

Rechargeable Systems

Fuel Cells

Hybrid Solution

BB2590 IDZ

Limited Candidates

Demonstrable Solution
~7Kg for 20W in 72h

Improvements:
4s3p Configuration
Cell improvements
Standards

Work in Progress

Identify and Investigate fuel cell/battery combinations

Significant weight reduction for DSS Loads
Continuity Risk (Generator)
Higher Cost
Maturity/Reliability
Consumable Fuel is key to reduced weight

Limited resource and time to complete objective by end of 2015

Ministry of Defence de&s

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Novel Fuel Systems for Consideration

Novel Fuel Cells

beupp

neahpower

myfcpower

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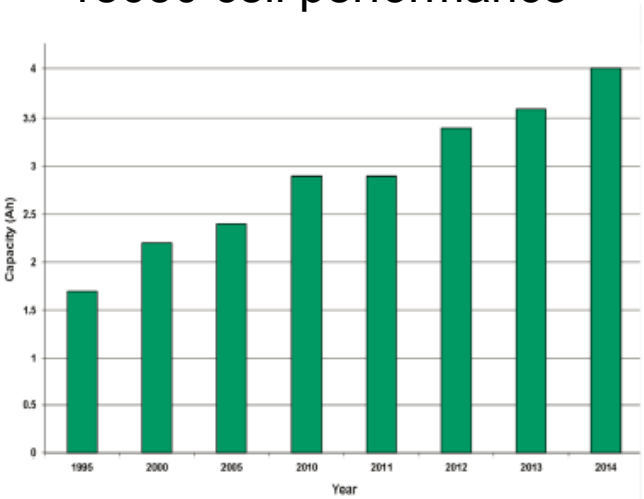
SMP NETT+ – Just one example of potential Hybridisation

18650 cell performance



SMP NETT + Battery

195 x 90 x 30mm

0.480 Kg

14.4V; 115Wh*

$7 connector

240 Wh/Kg

*Using current capacity cells (3.4 Ah)

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Next Steps

- Centralised power has distinct advantages in reducing the soldier burden
- Many nations have recently announced initiatives to explore such systems
- Our current portfolio of military batteries are not best suited to this approach
- Work to be done on Standardisation to meet the growing demand for centralised power
- Batteries alone are not the solution although they will be a key component for several years

Some form of hybrid using an energy generator in conjunction with a rechargeable storage device is the way forward.

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Finally – Thanks

- Thank you to the Organisers of JSPE for allowing me to introduce this work
- Thank you to the UK MoD for supporting QinetiQ in undertaking this package of work and agreeing for me to share it with you today
- Thank you to SAFT for undertaking the primary tests and Bren-Tronics for providing hardware to support the work so far.
- Thank you for listening

Thank you in anticipation of your support and to those of you who can make a contribution to this work, if you have data, information or contributions I would be willing to explain what we need

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Thank You for your Attention

Any Questions

QinetiQ Limited 2015

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