# nationalgrid

# Minutes

Meeting name Grid Code Review Panel

Meeting number 54

Date of meeting 21<sup>st</sup> March 2012 Time 10:00am - 4:00pm

**Location** National Grid House, Warwick, CV34 6DA

Attendees			
Name	Role	Initials	Company
Ian Pashley	Chair	IP	National Grid
Thomas Derry	Secretary	TD	National Grid
Robert Paterson	Presenter	RP	National Grid
Louise McGoldrick	Presenter	LM	National Grid
Kein-Arn Ong	Presenter	KO	National Grid
Shafqat Ali	Presenter	SA	National Grid
Bec Thornton	Member	BT	National Grid
Graham Stein	Member	GS	National Grid
Steve Curtis	Member	SC	National Grid
Audrey Ramsay	Member	AR	National Grid
John Morris	Member	JM	EDF Energy
Alan Creighton	Member	AC	Northern Powergrid
David Carson	Member	DC	SP Power Systems
Alan Barlow	Member	AB	Magnox
Barbara Vest	Member	BV	AEP
John Lucas	Member	JL	Elexon
Guy Nicholson	Member	GN	Senergy Econnect
Tom Davies	Member	TDA	Magnox
Alan Kelly	Member	AK	SPT
Steve Brown	Member	SB	Ofgem
Mike Kay	Member	MK	EŇW
Neil Sandison	Member	NS	SSE
Campbell McDonald	Member	CM	SSE Generation
Guy Phillips	Member	GP	E.ON UK
John Norbury	Alternate	JN	RWE
Alastair Frew	Alternate	AF	ScottishPower
Richard Lowe	Alternate	RL	SHETL
Jim Barrett	Alternate	JB	Centrica
Shijun Yi	Alternate	SY	Ofgem
Robyn Jenkins	Observer	RJ	National Grid
Apologies			
Name	Role	Initials	Company
Lisa Waters	Presenter	LW	Waters Wye
Brian Punton	Member	BP	SHETL
Dick Lewis	Member	DL	SONI
Kathryn Coffin	Alternate	KC	Elexon
Alan Michie	Alternate	AM	SPT
Gordon Kelly	Alternate	GK	ScottishPower
Xavier Pinchaux	Alternate	XP	RTE
Sigrid Bolik	Alternate	SB	REpower



# 1 Introductions & Apologies

2351. The Chair welcomed the group and the apologies were noted.

# 2 Approval of Minutes

# a) January 2012 GCRP Minutes

- 2352. The Panel approved the minutes for publication.
- 2353. ACTION: TD Upload minutes on to the National Grid website.

# 3 Review of Actions

# a) Summary of Actions

- 2354. It was noted that Minute 2327 was not on the Summary of Actions. IP will address this action under the European Network Codes section.
- 2355. Actions that relate to an item on the March 2012 GCRP Agenda are addressed under the respective section.

Wind Turbine High Wind Speed Shutdown – Additional Signal Requirement and Future Development Plan

- 2356. Minute 2206 GS informed the Panel that an invite has been sent out for a workshop which is taking place on 11<sup>th</sup> April 2012 at Wokingham with a 10:00am start. This action is completed and can be closed.
- 2357. Minute 2260 GS noted that Power Available would be included as part of the workshop. This action is completed and can be closed.

Information on Small Embedded Generation and its Impact on Transmission System Demand

- 2358. Minute 2212 GS informed the Panel that it was originally thought that this issue needed to be taken to the Distribution Code Review Panel (DCRP). However, through discussion, it has been determined that it does not and that Terms of Reference for a Workgroup will be brought to the May 2012 GCRP.
- 2359. **ACTION: GS** Submit draft terms of reference for this Workgroup to the May 2012 GCRP.

Fault Ride Through

- 2360. Minute 2220 GS informed the Panel that the paper has been reviewed by National Grid (this completes action 2220) and the main consideration to emerge from that was the difficulty of completing a site specific assessment for faults of duration greater than 140ms. This arises because the network is designed such that for secured events, if all equipment works as designed, faults should be cleared in shorter timescales. It is very difficult to create a requirement that can equitably applied to all users on a site by site basis, albeit in a limited number of cases. National Grid's current view is that it would be of more benefit to review the generic requirement if there was a need to do so.
- 2361. There are therefore 4 options for progressing this issue:
  - 1. Keep requirements as they are;
  - 2. Proceed to consultation with proposals as per pp12/04 for a site specific opt out for faults greater than 140ms;
  - 3. Proceed to consultation with proposals reviewing the generic requirements in the light of recent experience in both the UK and European context; and
  - 4. Initiate a formal Working Group under agreed terms of reference.
- 2362. GS also noted that the profile shown in the Requirements for Generators is different to the current profile under the Grid Code and that it is likely that profiles will change as a result of the European Network Codes.

- 2363. JM clarified that the proposal is more about can Fault Ride Through be looked at on a site by site basis in the situation where a User cannot meet compliance based on the general requirement.
- 2364. The Panel agreed that further debate and discussion is required and suggested that a meeting is arranged to progress the issue.
- 2365. **ACTION: GS** Arrange an industry workshop to expand on the options and discuss the issue.
- 2366. Minute 2222 SB informed the Panel that there is a derogation registry for Grid Code and SQSS, and that there is a regular meeting with NGET to discuss derogations. If circumstances change following the granting of a derogation, it is expected that the licensees will review the status of their obligation and that any material changes will be reported by the licensee to Ofgem. If circumstances change and Ofgem is not informed it is likely that the derogation would no longer be valid. Once Ofgem has been informed of a change they would then review the derogation. This action is completed and can be closed.
- 2367. MK noted that under the European Network Codes the derogation process would likely change as the codes are part of EU law and any derogation would have to be against EU law.
- 2368. JB questioned if the derogation register was publically available and SY confirmed that it is available on the Ofgem Electronic Public Register.
- 2369. **ACTION: TD** Send link to Electronic Public Register to the GCRP.

Grid Code Signatories

2370. Minute 2267 - TD informed the Panel that this is still to be completed but it will be done imminently. This action remains ongoing.

November 2011 GCRP

2371. Minute 2288 - TD informed the Panel that the November 2011 GCRP Minutes have been uploaded. This action is completed and can be closed.

Significant System Events Report (previously RoCoF Report)

- 2372. Minute 2303 & Minute 2305 SC informed the Panel that NGET have started to contact the parties involved and collate the data for the North of Scotland islanding (23 May 2011) event. It was noted that it was agreed by the Panel that all significant frequency events should be reported to the GCRP annually and the 23 May 2011 event will be included in the 2012 report. NGET are currently reviewing the triggers for a fax to be sent out to capture the events following their occurrence. Both actions remain ongoing.
- 2373. Minute 2016 SC noted that including an estimate of system inertia will be examined as part of putting together the 2012 Significant System Events Report. This action remains ongoing.

Sloy Busbar Outage

2374. Minute 2310 - TD informed the Panel that a summary of the issue had been sent to the STC which SHETL agreed to look over. It appears that information was passed along as quickly as it could have been and that due to unforeseen circumstances the Sloy Bus Bar outage had to be postponed because of Strathleven-Helensburgh circuit faults that could not be repaired in the original timeframe. If the Sloy outage had gone ahead the demand at Srathleven would have have been placed at unplanned single circuit risk for 4 days with Emergency Return to Service of 12 hours, this was the reason the outage was delayed. This action is completed and can be closed.

Demand Control (OC6) Paper

2375. Minute 2318 - SC informed the Panel that a revised date has been circulated for the Demand Control Workshop. This is now planned for 23 May 2012 at Wokingham and will include information regarding the recent use of Demand Control. This action is completed and can be closed.

2012/13 Membership

2376. Minute 2349 - TD informed the Panel that a wider invite had not yet been sent out but one would be circulated shortly. This action remains ongoing.

CACoP

2377. Minute 2349 - TD informed the Panel that no feedback was received and National Grid responded as Code Administrator. This action is completed and can be closed.

OC8 - Safety management of three position GIS earth switches

2378. TD informed the Panel that an industry consultation has been drafted at that it will be circulated shortly following the meeting today.

Generator Build

2379. Minute 2064 - TD informed the Panel that the paper was published for Industry Consultation on 03 February 2012 and closed on 02 March 2012. Three generally supportive responses were received. This action is completed and can be closed.

Codification of Generic Requirements currently included in the Bilateral Agreements

- 2380. Minute 2139 TD informed the Panel that National Grid is still looking into what could be published on the website regarding the appendix F template. GS explained that there are approximately 24 different templates and it will take NGET some time to publish something of use for the industry.
- 2381. JN noted that the purpose of the proposed publication was to improve the transparency as NGET often update the Appendix F with a new template when responding to a Modification Application.
- 2382. The Panel agreed that some discussion should be had between NGET and JN to determine a pragmatic way forward. Action 2139 can be closed as it is superseded by the following action.
- 2383. **ACTION: TD** Discuss issue with JN and bring a proposed solution to the May 2012 GCRP.

Voltage Fluctuations

- 2384. Minute 1997 GS informed the Panel that discussions had taken place and the next step is to update the draft Industry Consultation. A further teleconference is likely to be required to finalise the draft. This action can be closed as it has been superseded by the following action.
- 2385. **ACTION: GS** Update the draft Industry Consultation and circulate to the GCRP once complete.

Continuous Voltage Control

2386. Minute 2197 - GS informed the Panel that there are no developments that are not receiving their FON due to Continuous Voltage Control. On the question on whether it is possible to deliver continuous capability - the Panel noted that this is still an issue but agreed to close the action as it is covered on the Issues Summary.

# Offshore Wind Farms Not Connected To An Offshore Transmission System

- 2387. Minute 2314 SC noted that a paper (pp12/14) had been circulated on this topic. This action is completed and can be closed.
- 2388. The paper circulated is currently draft and aims to highlight the issues along with the difficulty in addressing the problem.
- 2389. The Panel agreed that there are a number of issues that need to be addressed regarding this issue including the impact of the European Network Codes.
- 2390. **ACTION: ALL** Review the paper and provide comments or alternative options to SC before the May 2012 GCRP.

#### 4 New Grid Code Development Issues

# a) Two Shift Limits

- 2391. CM presented the paper to the Panel.
- 2392. It was recognised that the EBSG Workgroup is examining Two Shift Limits (TSL) as part of their terms of reference but the concern is that a solution will not be put in place quickly enough and that a interim solution needs to be progressed with due haste. An EBSG Industry Consultation on TSL is currently planned to take place in April with conclusions being taken to the July 2012 GCRP.

- 2393. It was noted that there is not a industry consensus on this issue and that if TSL is drafted into the Grid Code as a formal parameter, as the paper suggests, appropriate legal text would need to be drafted, an Industry Consultation would need to take place, a Report to the Authority would need to be submitted and Ofgem would need to make a determination before it would become part of the Grid Code.
- 2394. The Panel noted the urgency described in the paper and agreed that the EBSG Industry Consultation should take this paper into account and be published in line with a time frame that will allow for industry views on TSL to be brought to the May 2012 GCRP. In recognition of the revised timescales the Panel agreed to accept a late paper on views from the TSL Industry Consultation.
- 2395. **ACTION: SA** Bring the industry views from the TSL Industry Consultation to the May 2012 GCRP.
- 2396. **NOTE**: At this point the Panel moved on to discuss item 6(g) before continuing with the Agenda.

# b) Seven Year Statement & Offshore Development Information Statement Review

- 2397. KO gave a presentation<sup>1</sup> to the Panel.
- 2398. Some concern was noted with regard to merging the contractual background based SYS with the scenario based ODIS as it might result in more effort to find the relevant information for Users. KO noted that the new document would have a clear distinction between current and future to facilitate finding relevant information.
- 2399. One member asked about the scenario consultation that had been undertaken. KO agreed to find out more detail and circulate the information to the GCRP.
- 2400. **ACTION: TD** Circulate information from KO to the GCRP.
- 2401. The Panel noted the update and that an Industry Consultation would be published on this. Any concerns or comments should be fed back to KO at <a href="mailto:kein.arn.ong@nationalgrid.com">kein.arn.ong@nationalgrid.com</a>.

#### c) Grid Code Governance Review

- 2402. LM presented the paper (pp12/17) to the Panel.
- 2403. It was explained that the Code Governance Review carried out by Ofgem only looked at the BSC, CUSC and UNC. NGET undertook a review of all the codes that it administers to see if any areas of the Code Governance Review are applicable.
- 2404. The Panel noted the paper and agreed to progress the changes to the Constitution and Rules.

# 5 Existing Grid Code Development Issues

#### a) Issues Summary

2405. TD informed the Panel that a review of the existing issues has been undertaken. It is proposed that we remove Grid Code Structure Review and as a review of the Grid Code Structure is not going to be conducted ahead of the changes from European Network Codes. The remaining items will continue to be kept under review and will aim to be progressed in line with the current dates. This completes action 2284.

#### b) Special Actions

- 2406. SC gave a presentation<sup>2</sup> to the Panel.
- 2407. It was noted that all proposed changes are internal to NGET and do not require code changes.
- 2408. The Panel noted the presentation and requested that it was worked into a paper for wider distribution and that it is taken to the Operational Forum.

67D166F3FBA1/53478/SpecialActionsMarch2012GCRP.pdf

<sup>1</sup> http://www.nationalgrid.com/NR/rdonlyres/A56DC95C-7E2B-4ABE-8636-8AB0A5CB9E9B/53477/SevenYearStatementOffshoreDevelopmentInformationStatementReview.pdf 2 http://www.nationalgrid.com/NR/rdonlyres/A684D2B6-0469-4769-B3E1-

2409. **ACTION: SC** Work the presentation into a paper for wider distribution and take it to the Operational Forum.

#### c) Hybrid Voltage Controls

2410. GS confirmed that there had not been any progress with this issue. It was noted that new resource will soon be available and it was proposed to bring back progress to the September 2012 GCRP.

#### 6 Workgroups in Progress

# a) Grid Code Connection Conditions for Small Embedded Power Stations

2411. SC confirmed that invitations will be circulated shortly and that the terms of reference for the Workgroup have been drafted. Action 2225 remains ongoing.

#### b) LEEMPS Compliance Assessment

2412. MK proposed that this item is removed from the Agenda until further notice as the European Network Codes need to be examined in more detail before it can be determined if this group needs to be established. This completes action 2228.

# c) Frequency Resilience of the Total System

- 2413. GS noted that discussions had been had with MK and that this issue will be taken to the DCRP and, subject to approval there, it will progress to a joint DCRP/GCRP Workgroup. This completes action 2230.
- 2414. MK highlighted that there was impact on this area from the Requirements for Generators European Network Code but this would be considered in the any Workgroup that was arranged.

#### d) Frequency Response

- 2415. TD informed the Panel that there are full operational forums planned for June 2012 and October 2012 with interim forums planned for August 2012 and December 2012. Depending on progress, it is planned to update the industry at the June or August forum. This completes action 2235.
- 2416. TD noted that a revised Terms of Reference was submitted (pp12/19) to take account of amended timescales. This completes action 2236.
- 2417. TD gave an update on progress since the January 2012 GCRP. The Workgroup last met on 1<sup>st</sup> March 2012 where they reviewed a draft of the Workgroup Consultation (pp12/20). This meeting concentrated primarily on reviewing the commercial section of the paper. A further Workgroup meeting is planned for 5<sup>th</sup> April 2012 to review the remainder of the paper and finalise ahead of publication. The Workgroup plans to submit a finalised version of the Workgroup Consultation to the May 2012 GCRP.

#### e) Harmonics (G5/4)

2418. GS informed that Panel that there was a Workgroup meeting on 8<sup>th</sup> March 2012 and they are currently awaiting results of some assessment work which is due to be delivered in May or June 2012. It was also noted that a paper is likely to be brought to a future GCRP regarding information exchange for the purpose of harmonic assessments.

#### f) BMU Configuration of Power Park Modules

2419. GS informed the Panel that the final Workgroup meeting had been held where the draft Workgroup Report was discussed. There are a few outstanding comments and questions but GS will revise Workgroup Report and agree final version ahead of May 2012 GCRP.

#### g) Electricity Balancing System Group

- 2420. TD informed the Panel that Simultaneous Tap Change is part of the specification for EBS and that the guidance note on the National Grid website has been updated to reflect the revised date. This completes actions 2252 and 2254.
- 2421. SA informed the Panel that the next meeting is on 27<sup>th</sup> March 2012 where it is intended to finalise the Two Shift Limits consultation. The Industry Consultation will be an EBSG consultation rather than a National Grid consultation.

- 2422. RP gave a presentation<sup>3</sup> on the Pricing Issue
- 2423. The Panel noted the presentation and that if raised as a BSC issue it would be possible to clarify what is possible with the new Electricity Balancing System and consult with the industry to determine progression. BV questioned the implications of the expected OFGEM cash-out review on the progression of this issue.
- 2424. Panel agree that it should be progressed to BSC issues group.

#### h) BM Unit Data from Intermittent Generation

- 2425. SC noted that the revised proposal was circulated and a few comments were received which will be reviewed before progressing. Action 2111 is complete as an update from the CBSG on their Intermittent Generation work will be placed under standing items for future GCRP meetings.
- 2426. **ACTION: SC** Review comments and update the Workgroup Report with discussions since closure of C/11 Industry Consultation.

#### i) Revision of CC.7.7 (Maintenance Standards)

2427. BT noted that updated Terms of Reference has been circulated to take account of other issues and that the next meeting is due to take place on 18<sup>th</sup> April 2012. This completes action 2264.

# 7 Workgroup Report

2428. There were no Workgroup Reports to consider.

# 8 Industry Consultations

# a) D/11: System to generator operational intertripping schemes

2429. TD informed the Panel that the consequential CUSC Modification CMP204 has been out for Industry Consultation and three responses were received. It is proposed that the Modification goes to the March 2012 CUSC Panel for a vote on whether or not it better facilitates the CUSC objectives.

#### A/12: Information Required To Evaluate Sub-Synchronous Resonance

2430. TD informed the Panel that the Industry Consultation was published on 05 March 2012 and will be closing on 26 March 2012. This completes action 2275.

#### 9 Pending Authority Decisions

# a) A/10: Generator Compliance

- 2431. SY informed the Panel that NGET had submitted A/10 to the Authority but there are concerns on the legal drafting. There have been a number of discussions between Ofgem and NGET regarding these concerns.
- 2432. TD confirmed that NGET is currently working towards addressing the concerns raised by the Authority.
- 2433. It was questioned whether the industry will get view of these concerns and conversations. TD confirmed that the Report to the Authority would be updated before being resubmitted to Ofgem. It was also stated that an open letter is likely to accompany the submission to explain what had happened since the original submission.
- 2434. A question was raised on how technical disputes on issues such as compliance are dealt with by Ofgem. SB confirmed that it is not the role of Ofgem to verify the technical detail provided by a licensee. If it was, then Ofgem could be held accountable for not verifying the technical information contained in derogations, disputes or modifications. Ofgem use the experience they have internally and the information presented to assess the proposal or derogation. The emphasis should still lie with the applicant to provide factually correct information but if there

<sup>&</sup>lt;sup>3</sup> http://www.nationalgrid.com/NR/rdonlyres/47CCABBF-0874-4D32-9F31-4E614D251E2C/53475/BMPricingIssueMarch2012GCRP.pdf

is indication of something incorrect, based on internal experience, Ofgem would secure the necessary resources to investigate this issue.

#### b) B/10: RISSP

- 2435. SY informed the Panel that NGET had submitted B/10 to the Authority but there are concerns that impact on Offshore parties has not been drawn out in the report. There are also a few reference errors that need to be addressed.
- 2436. TD confirmed that NGET is currently working towards addressing the concerns raised by the Authority.

#### c) H/11: Revision of Data Validation and Consistency Checking Rules

- 2437. SY informed the Panel that the report was submitted to the Authority for a decision on 7<sup>th</sup> February 2012 and that it was approved on 9<sup>th</sup> March 2012.
- 2438. TD confirmed that the changes were implemented on 16<sup>th</sup> March 2012.

#### d) F/11: Generator Build Due Diligence Review

2439. TD informed the Panel that this is due to be sent to the Authority imminently.

# 10 Standing Items

#### a) European Network Codes

- 2440. IP noted that the comparison between the Grid Code and Requirements for Generators (RfG) has been published. This completes action 2324.
- 2441. It was noted that the RfG formal consultation period closed on 20<sup>th</sup> March 2012. MK if it possible to lobby ENTSO-E on the consultation process as it took a significant amount of time to submit a response. IP noted that NGET submitted a response to the secretary regarding the process.
- 2442. There will be a workshop for the Demand Connection Code (DCC) on 18<sup>th</sup> April 2012 in Brussels. The next JESG meeting date is being moved to accommodate attendance at this workshop.
- 2443. The Capacity Allocation and Congestion Management (CACM) formal stakeholder consultation is due to be published shortly with the final code submission to ACER in September 2012.
- 2444. Framework Guidelines for Balancing are currently being drafted and expected to be available in draft from April or May 2012.
- 2445. GN noted that there was an EU consultation on "Establishment of the annual priority lists for the development of network codes and guidelines for 2013 and beyond" with a closure date of 16<sup>th</sup> April 2012.
- 2446. **ACTION: TD** Circulate link to *Establishment of the annual priority lists for the development of network codes and guidelines for 2013 and beyond* consultation to the GCRP.
- 2447. IP noted that the progression of changes to the Grid Code as a result of the ENCs depends on how the European Network Codes manifest themselves. It is currently envisaged that matters to be decided at a national level will be progressed in the normal governance process. This will be part of future ENC updates. This completes action 2327.
- 2448. IP also noted that it is not believed that the Grid Code will be changed to accommodate further data provision under REMIT and that submission of data to meet these obligations is unlikely to be under OC2. It was noted that the BSC Panel had considered the issues around data provision using 3<sup>rd</sup> Parties and highlighted the risk on Users being in breach if data is not published. This completes action 2339.

#### b) Joint European Standing Group

- 2449. BV informed the Panel that there is good participation from the industry and the group is addressing issues in a flexible manner as they emerge from Europe. It was noted that the Issues Logs are being added to and maintained and the work completed by NGET on the Requirements for Generators comparison was positively received.
- 2450. JN noted that the RfG Framework Guidelines provide for the application of standards and requirements to pre-existing significant grid users to be decided on a national basis. An early

indication from National Grid of its intentions to propose any additional Grid Code obligations on pre-existing users would be welcome.

# c) Space Weather

- 2451. SC gave a presentation<sup>4</sup> on notifications around Space Weather. This completes action 2331.
- 2452. It was questioned what constitutes a severe enough storm to trigger a warning and what form would the warning be in. SC noted that data from the Met Office was used to determine severity and that NGET would trigger the warning based on this data. The warning is a fax proforma similar to system warnings and is only sent when there is likely to be a severe storm within 12 hours. It was also explained that the fax is being reviewed to provide a gradient of warnings. It was also questioned if warnings could be sent through the BMRS.
- 2453. **ACTION: SC** Circulate the fax to the GCRP and investigate if warnings can be sent through BMRS
- 2454. SC also informed the Panel that the information that was submitted by Generators is being collated and the model for space weather is being updated. Once the model is updated there will be feedback sent to those that submitted information. This completes action 2332.

#### 11 Impact of Other Code Modification or Developments

# a) BSC

- 2455. JL informed the Panel that the June release of BMRS will standardise OC2 and SYS zones.
- 2456. It was also noted that P276 'Introduce an additional trigger/threshold for suspending the market in the event of a Partial Shutdown' will be going out to Industry Consultation shortly.

#### b) CUSC

2457. IP noted that CMP204 would be going to the CUSC Panel for a vote on 23<sup>rd</sup> March 2012.

#### c) Cross Codes Forum

- 2458. TD informed the Panel that the last Cross Codes Forum that was due to take place on 17<sup>th</sup> February 2012 was cancelled due to lack of attendance.
- 2459. BT noted that NGET still believe that it is a worthwhile forum and would encourage wider participation. BV added that a quarterly newsletter to substitute few meetings may be worth considering.

#### d) Operational Forum

2460. The last Operational Forum held on 23<sup>rd</sup> February 2012 with the next one taking place on 12<sup>th</sup> April 2012. It was noted some slides on Demand Control were shown as well as some discussion around the voltage issues experienced in the Southeast.

# 12 Any Other Business

- 2461. TD noted that the final conclusions of the SQSS Governance Review had been published and the main changes are the inclusion of a Generator and DNO representative on the Panel.
- 2462. CM raised the issue of System Operator Transmission Owner outage notification to Users and coordination with Users under OC2, as there were no further actions from Minute 2310 to report findings. CM asked if the STC Processes were followed correctly for the Sloy Bus Bar outage and the catalogue of recent Hadyard outages. CM also asked if there were any lessons that were learnt that can be taken forward with the STC panel to improve the process.

# 13 Next Meeting

2463. The next meeting is planned for 16<sup>th</sup> May 2012 at National Grid House, Warwick.

<sup>4</sup> http://www.nationalgrid.com/NR/rdonlyres/CC395FDB-D7B7-41D7-9B81-2F8800AC70F7/53479/SpaceWeather.pdf