



Network Emergency Coordinator (NEC) Industry Exercise 'Zeus' 2018

Industry Post Exercise Report

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NEC

Executive Summary

The Network Emergency Co-ordinator (NEC) is an independent industry role, established under the Gas Safety (Management) Regulations (GS(M)R), whose duty is to co-ordinate the actions across affected points of the gas network to prevent or minimise the consequences of a Network Gas Supply Emergency; this is defined as “an emergency endangering persons arising from a loss of pressure in a network or part thereof”. The role of the NEC is currently undertaken by National Grid Gas and is independent from any commercial interests of any organisation within the Gas Industry.

Industry participants such as Gas Transporters and shippers have a legal duty to cooperate with the NEC, who has the powers to direct the defined duty holders. The arrangements and procedures put in place to facilitate these powers are tested annually and this report covers the 2018 NEC Exercise “Exercise Zeus”.

Over 300 industry representatives participated in the 2018 exercise and observers from the Health and Safety Executive (HSE) were in attendance at National Grid Gas’ offices in Warwick and the response locations of selected Distribution Networks. This provides a high-level assurance to the NEC that the entire industry is able to adhere to the emergency arrangements and procedures.

From the direct observations by the NEC, engagement by the industry during the exercise and subsequent reports submitted; the NEC is satisfied that the industry has successfully demonstrated that it is able to effectively respond to a Gas Deficit Network Gas Supply Emergency (NGSE), in accordance with the current emergency arrangements, and protect the general public and the gas network.

The exercise provided an opportunity for all parties to reflect on their processes and interactions and from this action areas for 2019 have been developed. National Grid and the gas Distribution Networks have shared these action areas with the NEC and these will be tracked and reported on throughout the coming year. The key identified priority areas for development are; continued enhancement of the information and situational awareness sharing protocols between the Gas and Electricity response, delivering a restoration exercise in 2019, and further developing the process for the NEMT to determine figures associated with emergency actions in the Local Distribution Zones (LDZ).

Exercise Zeus is assessed by the NEC as having provided appropriate levels of assurance of the industry’s ability to respond to a Gas Deficit NGSE and also as having provided valuable learning and experience to the wider Gas Industry.

A note from the NEC:

Thank you to all those who participated in Exercise Zeus. Once again we have successfully demonstrated preparedness across the network ahead of the winter and identified focus areas to continue to improve how the industry responds. This was only achievable thanks to the enthusiasm of over 300 participants who treated the exercise as if it were a real event, whilst still managing operational commitments.

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1 - Introduction

To prevent a gas supply emergency occurring, or to minimise the safety risks associated where one develops, the Network Emergency Co-ordinator (NEC) has arrangements established, pursuant to the Gas Safety (Management) Regulations 1996, for coordinating the actions of duty holders, including transporters operating on the affected part of the network. In accordance with the NEC's Safety Case obligations these processes are tested on a periodic basis to ensure that arrangements are appropriate, robust and duty holders are cognisant of their responsibilities.

The 2018 NEC emergency exercise, "Exercise Zeus", was split into three separate stages to allow more focus on specific key areas of the emergency process. This report covers:

- National Grid **Pre-Emergency Commercial Strategy Exercise** (Pre-Emergency Day), 12th September
- **NEC Industry Exercise** - Gas Deficit Emergency (GDE) exercise (delivered over two days), 3rd and 4th October
- Individual **Distribution Network Firm Load Shedding (FLS) exercises** – various dates between Pre-Emergency Commercial Strategy Exercise and the NEC Industry Exercise, at the discretion of the DNs.

Annual exercise programme: The Gas Industry also undergoes a wide range of other preparedness exercises throughout the year, for example, smaller more localised Critical Transportation Constraint (CTC) exercises are tested between National Grid and the individual Distribution Networks.

This report has been authored by the Office of the NEC. It serves as a record of the three stages of Exercise Zeus. The scenario is summarised in [Section 4](#) and an overview of the response provided at [Section 5](#). Detailed learning points are highlighted throughout the response overview ([Section 5](#)) and high level action areas have been collated in [Section 7](#). Assurance that the exercise achieved its objectives is provided in [Section 8](#). [Section 9](#) further details the sources of feedback utilised to prepare this report.



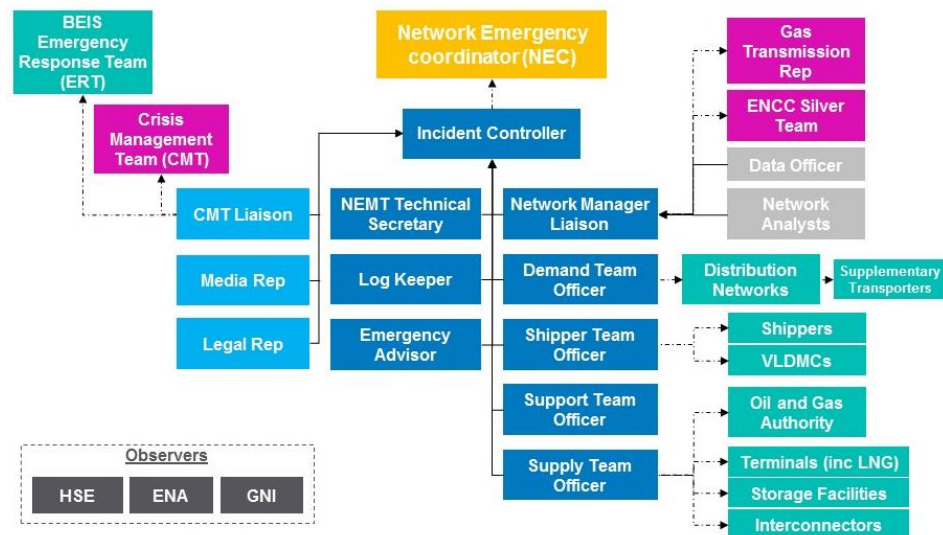
Over 300 industry participants took part in Exercise Zeus

2 - Participants

National Grid estimates over 300 industry participants took part in Exercise Zeus (further illustrated in Figure 1) from across a range of areas including:

- Network Emergency Coordinator (NEC)
- National Grid
 - Network Emergency Management Team (NEMT)
 - Representation from the Gas National Control Centre (GNCC)
 - Electricity National Control Centre (ENCC) Silver Team
 - Representation from Gas Transmission
 - Representation from the National Grid Crisis Management Team (CMT)
 - Representatives from National Grid’s Legal and Corporate Affairs departments
- Gas Distribution Network Operators (DNs)
 - Cadent Gas (CAD)
 - Northern Gas Networks (NGN)
 - SGN
 - Wales & West Utilities (WWU)
- HMG Department for Business, Energy & Industrial Strategy (BEIS)
- Shippers
- Terminal Operators, including LNG Importation Terminal Operators
- Interconnector Operators
- Storage Facility Operators
- Supplementary Transporters
- NTS Directly Connected Loads (VLDMCs)
- The Oil & Gas Authority (OGA)
- Electricity Distribution Network Operators

Figure 1 – Exercise Zeus Participants



Not mentioned in the exercise objectives, but for inclusion in those of future years, is that the annual industry exercise allows National Grid, and other participants, to assure the competency of the individuals which make up the various response teams. The simulation provides a means as close to reality as is possible, outside of a live response, to induct new responders and thoroughly practice those who already have a role.

3 - Objectives

The overriding aim of this exercise was to provide a vehicle to test NEC communications, and associated processes, to the UK Gas Industry in order to demonstrate the industry's ability to effectively respond to a Network Gas Supply Emergency. In doing so the following objectives were met:

- Ensure effective communication between Gas Transporters and regulatory and government departments
- Test the upstream management procedure, web portal and emergency response communications
- Practice the response link between localised transmission and national supply emergencies
- Test the escalation to and interaction between crisis management teams
- Embed, for testing, recommendations from previous industry emergency exercises, including Exercise Yield (2017), and lessons learnt from live events on the 1st and 2nd March (2018)
- Validate emergency procedures, specifically E1, National Grid's E3, the E3 documents of the Distribution Networks and the NEC Safety Case
- Build on the current understanding of Electricity Industry interaction during a major gas event through expanded electricity sector engagement
- Assure the effectiveness of communications between gas Distribution Networks and HM Government, with a focus on the local impact of national emergencies with regard to sites impacted and welfare arrangements arising
- Create a basis to deliver a restoration stage exercise at a later date.

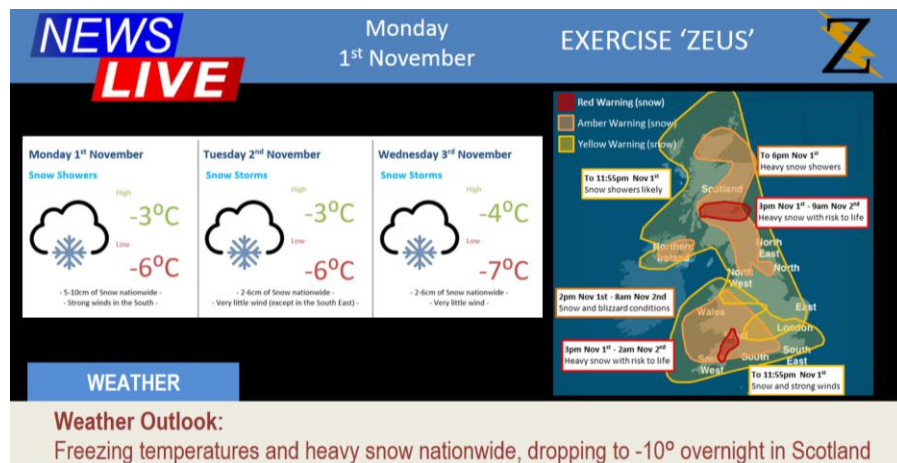
[Section 7](#) of this report considers each of the above exercise objectives in turn and determines what assurance was obtained for each.

4 - Scenario

The key theme across the scenario for all three days of Exercise Zeus was a high demand for gas and losses effecting the gas supply pattern. The initial status and subsequent injects were based on the live events of the 1st March 2018 where a high demand for gas was caused by the ‘Beast from the East’ weather pattern (re-titled ‘Nuisance from the North’ for exercise purposes) and a series of supply losses, due to severe weather (Figure 1), affecting input terminals across the UK. This scenario served as the basis for the Pre-Emergency Day, which was carried out on the 12th September.

The days which followed the 1st March 2018 were managed for real using the standard physical and commercial strategy. However, to assure Emergency tools could be tested during the Industry Exercise, the real events were exacerbated with a series of injects, for days one and two, to provide a situation where a Network Gas Supply Emergency would be required.

Figure 1 – Exercise Weather



Tables 1, 2 and 3 highlight the key injects of the scenario relevant to each day of the exercise:

Table 1 – Pre-Emergency Day Starting Position

SAP: System Average Price – The aggregate price traded for a specific delivery day.

Inject:	Potential:	Expected Response:
<p>Instability in Algeria: An underlying threat of instability in European gas prices in response to a fictional rebel takeover of the North of Algeria, the location of the country’s key oil and gas export facilities namely: Hassi R’Mel Gas Field, Arzew LNG terminal, Bethioua LNG Terminal and Skikda LNG Terminal.</p>	<p>European prices to rise above UK gas prices leading to the interconnectors ceasing import from Europe (BBL) / exporting to Europe (I(UK)).</p>	<p>National buy actions to push SAP higher than European prices.</p>

OM: Operations Margins
 – A service maintained at levels and locations determined throughout the year for the purpose of maintaining system pressures in the period before other system management services become effective.

<p>Storage deliverability limitations: Despite storage being collectively 58% full, the sites with the highest delivery rates are the least full having maximised delivery in response to a fictional price spike in the month preceding the exercise.</p>	<p>Storage sites unable to deliver maximum flows and risk breaching the deliverability safety monitor.</p>	<p>Monitor the deliverability safety monitor and the amount which storage withdraws.</p>
<p>Extreme weather: The real weather data of the 1st March was utilised, the weather pattern coined 'Beast from the East' was re-titled 'Nuisance from the North'. Yellow, Amber and Red weather warnings, and nationwide low temperatures, of the 1st March 2018 were replicated.</p>	<p>High gas demand in response to cold weather and snow fall, with a re-forecast of higher demand mid-morning as the UK public stay at home instead of going to work.</p>	<p>Encourage more gas onto the NTS through the commercial strategy i.e. off peak capacity scale back and use of Operations Margins.</p>

Table 2 – NEC Industry Exercise Day 1 Starting Position

Inject:	Potential:	Expected Response:
<p>Storage site failures: Hornsea and Aldbrough storage sites trip due to extreme cold weather effecting the plant, freezing and damaging valves at both sites.</p>	<p>Loss of within day supply and impact to the storage deliverability curve.</p>	<p>Commercial actions to encourage other storage sites (and Terminals) to balance the deficit.</p>
<p>Response to Buy actions: I(UK) and BBL Interconnectors increase import flows to maximum in response to a scripted buy action in the early hours of the morning.</p>		
<p>Kings Lynn compressor failure: Kings Lynn compressor station suffers an outage following a barrage of blizzards eventually freezing the plant's air intakes. This requires the issue of a Terminal Flow Advisory (TFA) notice to the Bacton Terminal as pressures cannot be distributed effectively.</p>	<p>Loss of Kings Lynn causes a constraint to the South East requiring pressures to be reduced at Bacton This inject also introduces concern for pressures in the extremities of the South West of the UK.</p>	<p>Issue a TFA and take locational actions to increase pressures in the South West.</p>

Sleipner Pipeline Shutdown: A vessel collision with the Sleipner platform requires a platform evacuation shutting down the Langeled pipeline.	Significant supply losses severely impacting the supply and demand balance	Declaration of an Emergency at Stage 2 in order to maximise supplies and reduce demand
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Table 3 – NEC Industry Exercise Day 2 Starting Position

Inject:	Potential:	Expected Response:
Redirection of LNG shipment: Nominated flows from LNG terminals are lower than forecast due to an expected shipment, due 4 th November, being re-directed to Japan.	An increase to the imbalance carried into the next gas day.	Continue Emergency Stage 2 load shedding of demand in the LDZs to counteract the imbalance.
Storm ‘Gareth’: A storm forecast to roll up the North Sea (Storm ‘Gareth’) results in a series of supply losses, totalling 50mcm, due to precautionary evacuations of several offshore installations.	Significant supply losses severely impacting the supply and demand balance	Declare a Stage 3 Emergency to balance the supply losses with a reduction in allocation of gas to Distribution Networks requiring isolation of domestic consumers in the LDZs.

5 - Overview of the response

5.1 Pre-Emergency Day

During the Pre-Emergency Day exercise, Distribution Networks, the Energy Networks Association and Gas Networks Ireland were invited to observe events alongside the HSE at National Grid's offices.

Summary

Replaying the events of the 1st March 2018, allowed a large range of real data to be utilised bringing a much broader level of realism to the exercise than has been seen in the Pre-Emergency Day to date. This in turn allowed a detailed response to unfold, at pace, which included the revisiting of key considerations such as the issuing of a Gas Deficit Warning (GDW) and the many other commercial, pre-emergency, strategies available.

Knowledge sharing through observation: For the second year, during the Pre-Emergency Day exercise, DNs were invited to observe events alongside the HSE at National Grid's offices. This year, the invitation was extended resulting in attendance from the Energy Networks Association (ENA) and Gas Networks Ireland (GNI). This proved to be extremely beneficial giving all parties a deeper appreciation for the actions taken in the lead up to a potential gas supply emergency. This will be continued into future exercises with additional effort made to expand the range of interfaces observed, beyond the periodic briefing of the NEMT.

BEIS also attended National Grid's Offices which enabled representatives to observe the NEMT response whilst role playing the Emergency Response Team's (ERT) pre-emergency actions.

The Pre-Emergency Day was focused on the use of commercial tools that would attempt to mitigate any potential supply emergency.

Initiation

To begin the exercise, the supply losses which occurred for real on the 1st March 2018 were injected to the GNCC Duty Officer. The supply losses resulted in significantly below target Predicted Closing Linepack (PCLP) and forecast for instantaneous line pack to drop well below normal operating range, risking missing the DN's minimum pressures at 22:00. This potential triggered the formation of the Network Emergency Management Team (NEMT) headed by an Incident Controller (IC).

Initial actions

Upon formation, the NEMT utilised an enhanced Briefing, Meeting, Working cycle allowing the IC to quickly brief the NEMT Officers and allocate actions for them to begin establishing response communications with industry. This led to early contact with BEIS, a notification to the HSE and notional contact with the DNs and Supply Terminals, to gather a broader situation awareness of the supply demand picture.

Commercial strategy

Before issuing a Gas Deficit Warning, the NEMT instructed the GNCC to take buy actions on the commodity market (OCM) increasing the cost of gas in the UK market to encourage shippers to increase supply into the UK.

Linepack: The volume of gas stored in pipes. The higher the linepack the higher the pressure across the Network.

Gas Deficit Warning

The GNCC's buy actions saw minimal market response and therefore the NEMT instructed the issuing of a Gas Deficit Warning (GDW) to further encourage shippers to balance the system. The significance of the GDW and further buy actions saw the system return to balance by the end of the exercise, with a fictional night shift left to attempt to recover the light opening position.

5.2 NEC Industry Exercise Day 1

Summary

The NEC Industry Exercise background scenario is a follow on from the Pre-Emergency Day Exercise. This year the live events of the 1st March provided a data rich and realistic basis to develop a more severe picture from the actual position on the 2nd March. The response continued from the Pre-Emergency Day with a new shift, comprising the full NEMT, simulating a hand-over from a notional night shift.

Day 1 of the NEC Industry Exercise focused on a Network Gas Supply Emergency (NGSE) Stages 1-2.

Initiation

After the initial briefing of the NEMT, communications were promptly re-established with BEIS, the HSE and National Grid response teams. As the industry exercise involves a wider participation than the Pre-Emergency Day, live communications were established with the DNs and Supply Terminals. The initial plan of the NEMT was centred around information gathering, therefore NETMAN 1 forms were requested from the DNs and the Oil and Gas Authority were requested to activate the Gas Availability Status (G.A.S) Report.

Declaration of an Emergency

Analysis of the situational awareness data obtained from contact with the DNs and Supply Terminals, made it clear to the NEMT that the commercial actions, continued from the Pre-Emergency Day, were not sufficient to resolve the scenario. A strategy was therefore presented to the NEC ([Section 5.3](#) provides a detailed review of the NEC briefing process) that required the declaration of a Gas Deficit Emergency. The tools available at Stage 1 were insufficient to rebalance the system, therefore approval was sought from the NEC to declare Stage 1 and 2 in parallel.

Learning point # 1 - Despite pre-briefings including exercise rules requiring all communications to be pre-fixed with 'Exercise Zeus', the emergency declaration message was issued to industry without an exercise pre-fix. This was reactively managed but did cause some confusion across the industry. National Grid's Gas Emergency and Incident Framework Team (E&IF) will instigate a review of the proformas utilised for the preparation of industry declarations and assure that the procedures clearly state the requirement to pre-fix messages sent for exercise with the appropriate mark up.

It was identified post exercise that the NEMT Demand Team missed that SGN had storage available which could have been utilised under Stage 1 actions. Whilst this storage would not have averted the declaration of Stage 2, it is important that all available gas is utilised to minimise the impact of the deficit on customers and, later, domestic consumers.

Learning point #2 - The E&I Team will ensure this lesson is built as a case study into future Demand Team training to assure that the Demand Team maximise all options available regardless of whether they avert the need to move to a subsequent Emergency Stage.

Electricity Industry interaction

Communications were re-established with the National Grid Electricity National Control Centre (ENCC) through the Network Manager Liaison position in the initiation of the day 1 NEMT shift. Communications centred around the potential for load shedding on the NTS. With the majority of NTS directly connected sites being gas fired power stations, the impact on the electricity network of the NEMT conducting load shedding of directly connected sites can be significant - depending on volumes, electricity demand and generation mix at the time. The procedure for load shedding on the NTS is designed in cognisance of this effect on electricity and is the safest option for domestic customers.

Learning point #3 – The richness of the scenario this year allowed a greater focus on the method for Gas and Electricity sharing situational awareness across the response. This allowed identification of the need to continue to enhance this protocol to provide a solid information exchange in order to risk assess the cross-network implications of response actions. Sessions to facilitate both parties achieving a high level understanding of each other's emergency processes have already been booked. Efforts to enhance communications will be tested in an exercise between Gas and Electricity in 2019, ahead of the next NEC Industry Exercise.

Learning Point #4 – Already a consideration for the E3 Alignment Group is the hypothesis that: as LDZ networks continue to diversify, the load shedding of gas fired power generation on the NTS will encourage demand to increase on the LDZs as gas fired generation embedded in the LDZ increases to counter the deficit on the electricity network. The E3 Alignment Group will continue to monitor and mitigate against LDZ demand increases associated with load shedding on the NTS.

With the declaration of a Stage 2 Emergency imminent, the NEMT liaised with the ENCC Silver Team to determine a load shedding strategy which did push the Electricity Network into a degree of stress, but assured the network was resilient against a full blackout.

The involvement of the Electricity Distribution Networks in Exercise Zeus was through a separate but parallel exercise that BEIS ran to test the load reduction protocols which are laid out in Electricity Supply Emergency Code.

Maximise Supplies

The amount of head-room available at each supply terminal, which had not been encouraged to flow commercially, was identified early in the response via the G.A.S. Report. The live completion of the G.A.S. Report for Exercise Zeus proved successful, continuing to demonstrate its value in a response. 16 of the 19 terminals completed the report within one hour. Follow up calls to the terminals with data outstanding quickly allowed a full report to be compiled.

In the face of the scripted supply loss at Easington, the NEMT Supply Team were instructed, in line with the approval of a Stage 2 Emergency, to contact each terminal and instruct them to maximise their flows. This was promptly achieved with all terminals which had head-room (all be it scripted) agreeing to maximise flows.

Load shedding

The load shedding element of the Stage 2 Emergency actions is closely reviewed and carries with it a suite of data and associated analysis. Therefore,

a record of the load shedding elements of Exercise Zeus is detailed separately in [Section 6](#).

Communications

Clear communications are a key aspect to the response to an emergency. Across such a broad range of stakeholders, which make up industry, clear communications will always be a challenge. Various processes and practices are in place to assure the correct communications are received by the correct organisations. The E&IF Team have collected data regarding missed communications and incorrect contact details arising from Exercise Zeus and will work to correct these. Included in this topic is the requirement to communicate key information via teleconference between the NEMT and the DNs. Already identified is the requirement to summarise these communications in writing in order to mitigate misunderstandings. The E3 Alignment Group will continue to enhance the process for summarising key instructions in writing using Critical Transportation Constraint exercises scheduled for February 2019 to further test this process.

Similarly, observers of Exercise Zeus identified that over the years which have passed following the separation of Distribution Networks, cross network knowledge of staff taking a response role has inevitably gradually reduced. The E3 Alignment Group exists partly to mitigate this reduction of cross network knowledge. Various exercises and events are held to increase a broad understanding of the whole network amongst responders. This will never fully replicate a working understanding that was once common place. It is therefore important to complement the activities of the E3 Alignment Group with additional context when instructions are given to the DNs during a response. This context should aim to outline the purpose and implications of any instruction or direction given to the DNs to allow a boarder understanding and encourage suitable challenge.

Learning point # 5- The E3 Alignment Group will create a pro-forma to collate a written summary of key communications between the NEMT and the DNs. This pro-forma will include a prompt to outline the potential implications of any instructions or directions.

Handover

Preceding the exercise pausing overnight, and recommencing with a new NEMT shift on day 2, an Officer handover was conducted. This was assessed to be effective although the exercise did not test the handover of individual team members, relying on the officers to brief incoming staff. It was fed back that a handover individual to individual would be beneficial and is achievable through shift timings. This has been identified by National Grid as an internal learning point. The NEC also practiced the process of handing over to an NEC Officer. As the Officer in question was observing the response on day 1 it is difficult to assess the success of this handover. Handover pro-formas will be considered as a result of learning point #6 identified overleaf.

5.3 NEC Industry Exercise Day 2

Summary

Day 2 of the Industry Exercise focused on a Network Gas Supply Emergency at Stage 3. Lighter participation is involved in day 2 with a focus on communications with the DNs to determine a suitable reduced allocation of gas and the isolation of parts of the LDZs to achieve this reduction.

Stage 3 is a significant stage of an emergency as it presents the first occurrence of domestic load being directly affected by the response. BEIS therefore held a DN teleconference part way through the day to simulate the focus which would be placed on the welfare arrangements arising from the isolation of domestic customers. A restoration exercise will be held in 2019 to continue the response scenario into a Stage 4 Emergency (restoration). The Ministry of Housing, Communities and Local Government will be invited to participate, further exploring the humanitarian issues associated with isolation and subsequent restoration.

Initiation

The final day began with the system being balanced due to the use of Stage 2 tools the previous day positively compounded by the roll-over of the new gas day.

Looking ahead to subsequent days revealed there would be an imbalance due to diminishing gas delivery rates of the storage sites and gradual reduction of LNG, as stocks depleted and planned redeliveries were rerouted.

Initial actions

As the NEMT re-established communications with their stakeholders, the impact of Storm 'Gareth' hitting the North Sea was injected. A series of supply losses again resulted in an imbalance of supply and demand. With supplies already maximised and load shedding being unable to address the issues in full by the end of the gas day, the NEMT required to develop a Stage 3 strategy.

Declaration of Stage 3

Determining the strategy for the reduction of the allocation of gas to the DNs, and the associated isolation of parts of the LDZs, requires the NEMT to calculate what level of isolation it requires from the DNs. As the impacts of Storm 'Gareth' only became applicable six to seven hours into the gas day, the effectiveness of isolating small areas of the LDZs was reduced. A significant isolation strategy was therefore required. The NEMT requested options, up to a worst case figure of a 40% isolation, requesting the DNs to conduct analysis on how much demand this would reduce.

The 40% figure generated detailed discussion between the DNs and the NEMT. This was an unprecedented isolation percentage which led to a degree of alarm across the participants. The task of working back from the worst-case figure proved to be a difficult one with both the NEMT and the DNs expecting the other to provide an ultimate figure for how much gas required to be secured/would be secured.

Learning point # 6 - The E3 Alignment Group will work to predetermine the wording of the requests made to the DNs to determine a suitable isolation value. The learning suggests that the pre-determination of value ranges i.e. 0-10%, 20%-30% would be a less alarmist means of determining realistic values. The group will also request the DNs share the content of their isolation plans with National Grid through a knowledge sharing session to allow a better understanding of the levels of isolation which are achievable and the timings associated with their implementation.

NEC briefings

The NEC was active throughout all three days of Exercise Zeus. The NEC and Officers separated themselves from the NEMT response, accurately simulating the requirement for the NEC to remain impartial from the NEMT response. Not

entering the Incident Room during the pre-emergency phase did however lead to a lack of situational awareness that could be picked up, albeit artificially, by observing NEMT briefings. This situational awareness cannot be replicated by the IC strategy briefings alone.

Learning point # 7 – A formal process should be introduced for the development and provision of a periodic briefing pack to the NEC to complement IC strategy briefings. Best practice will be sought from similar positions in other industries i.e. the Secretary of State Representative (SOSrep) position utilised by BEIS for the management of offshore pollution incidents associated with oil and gas infrastructure.

Media Management

Across all three days of Exercise Zeus, consideration was given to the management of media queries and the use of communications channels to deliver emergency related messaging. The events of the 1st March demonstrated that media queries require a great deal of time and effort to manage. Exercise Zeus did not replicate this pressure, exercise facilitators choosing instead to hold a separate event to test the Energy Networks Association's (ENA) Gas Incident Protocols and a detailed review of the Public Appeals process.

Learning point # 8 - The Communications Task Group will be requested to manage the development and delivery of a Communications Exercise in 2019. The exercise will test the interrelation and interaction between communications teams across National Grid, the DNs and BEIS through the ENA. A recent review of the public appeals process will also be covered in this event.

End of Exercise

Exercise Zeus was not designed to allow time to ultimately 'fix' the issues presented across the response. Indeed, it was designed to create a basis to conduct a follow-on restoration exercise at a later date. The situation at 'End Ex' was therefore left with the DNs initiating isolation of the LDZs.

5.4 Overall response summary

Using live data and adding realism to the scenario through more focus on the story behind injects, allowed a detailed response which unfolded with positive momentum across the three days of the exercise. The participants across the organisations involved in the exercise demonstrated a positive commitment to the response allowing the issues generated to be discussed and managed in a manner as close to reality as is possible in an exercise. The response was an extremely positive one which will only be enhanced by the learning points and associated actions which will be completed across 2019 in readiness for both the 2019 Exercise and real life events.

National Grid's E&IF Team has collated a detailed list of feedback and learning points over and above the high-level observations listed in this report. These learnings will be assessed by the E&IF Team and appropriate actions completed to remedy delta points. The E&IF Team reviews this list monthly to assure all actions are closed out in time for the next NEC Industry Exercise.

A summary of the actions tested in Exercise Zeus is shown in Table 4. A high-level step through of the scenario and the points at which actions were taken is included in [Appendix I](#).

Table 4 – Emergency Actions tested in Exercise Zeus

Emergency Stage	Action	Tested in Exercise
Stage 1 (Potential)	<ul style="list-style-type: none"> Gas conforming to Schedule 3 Part II of GS(M)R 	No
	<ul style="list-style-type: none"> NTS Linepack utilisation 	Yes
	<ul style="list-style-type: none"> Distribution Network Utilisation <ul style="list-style-type: none"> Distribution Network Storage Emergency Interruption 	Yes (Data gathering only)
	<ul style="list-style-type: none"> Public Appeals 	No
	<ul style="list-style-type: none"> National Grid Gas plc's participation in the OCM will be suspended 	Yes
Stage 2	<ul style="list-style-type: none"> Maximise Supplies 	Yes
	<ul style="list-style-type: none"> Load Shedding 	Yes
	<ul style="list-style-type: none"> Public Appeals 	No
Stage 3	<ul style="list-style-type: none"> Allocation & Isolation 	Yes
	<ul style="list-style-type: none"> Public Appeals 	No
Stage 4	<ul style="list-style-type: none"> Restoration 	No

6 - Load Shedding

A key activity in Stage 2 of an NGSE is load shedding. Exercise Zeus tested the ability of National Grid to contact and achieve a reduction in gas supplied to loads directly connected to the NTS as well as the DN's ability to do the same for their largest 200 sites in each of the Local Distribution Zones. The load shedding exercise for the DNs was not undertaken on the day of the NEC Industry Exercise, to allow for the resources required for the exercise to be managed effectively and ensure minimal impact to business as usual activities. The reduction in pressure associated with isolating this element from the industry exercise also allowed for better interaction between the DNs and their top 200 sites resulting in more robust contact details being obtained.

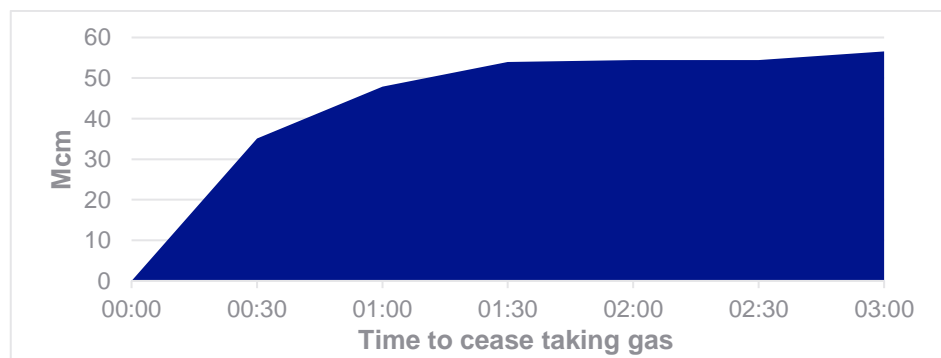
Load shedding on the NTS

During Exercise Zeus NTS directly connected sites were contacted and their gas supply reduced (by simulation) in real time, with different tranches of customers taken at different times within the exercise. Due to this approach, which best simulates reality, the National Grid element of the load shedding data does not allow analysis of the time taken to contact sites. However, across the exercise National Grid was able to contact 91% of the directly connected NTS sites. 100% of the sites confirmed they could cease taking gas, 86% within an hour. This result, over 49 sites, is greater in volume than that which the DNs are able to achieve in the same time across 2638 sites, highlighting the importance of load shedding on the NTS.

The success rate in contacting directly connected sites is equivalent to previous years. However, the ability of these sites to cease taking gas reduced from previous years with 14% of the sites needing longer than one hour, compared with 100% of the sites ceasing taking gas within the hour during Exercise Yield 2017. The target set by the NEC Safety Case forum for this load reduction is to 'successfully deliver the instruction to reduce 90% of the available load within one hour'. This target was missed by 6%. National Grid will investigate the root cause of this change and feed lessons learnt into the process and share amongst the attendees of the E3 Alignment Group.

Chart 1 shows the time it took, from first contact, for each of the customers who were scripted to be taking gas to cease taking gas. The curve depicts the resultant demand reduction.

Chart 1 – Total NTS Demand Reduction



Learning Point # 9 National Grid will continue engagement with customers to remind directly connected sites of their obligations and periodically review contact details to ensure that there is no delay in making contact with them in the future. The E&IF Team will also enhance NEMT Shipper Team Training to cement the requirement to instruct sites to cease taking gas safely, as soon as possible.

Load shedding in the LDZs

The load shedding exercises for the Distribution Networks took place outside the two days of the NEC exercise. The following analysis focuses on performance across the DNs regarding the three key measures of contact success within Exercise Zeus:

- Number of sites where contact was made and site would stop using gas
- Number of sites where contact was made and site would not stop using gas
- Number of sites who could not be contacted

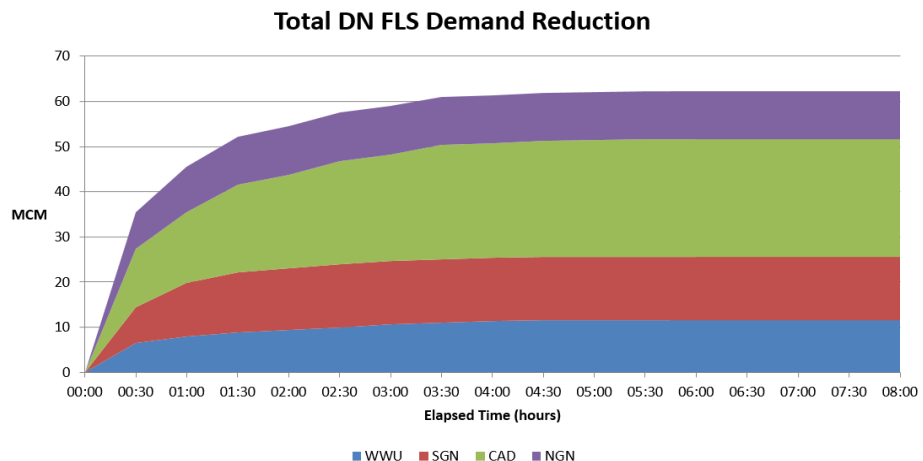
Table 5 shows the aggregated data across all the DNs. It shows, compared to last year's exercise, that all measures have collectively demonstrated improvement.

Table 5 – Aggregated DN firm load shedding data

Exercise Name and Year of delivery	No of sites attempted to be contacted	No of sites where contact was made and site would stop using gas			No of sites where contact was made and site would not stop using gas			No of sites who could not be contacted	
Zeus 2018	2638	2088	79%	180	7%	370	14%		
Yield 2017	2633	2031	77%	200	8%	402	15%		
X-Ray 2016	2662	1935	73%	232	9%	495	19%		
Wolf 2015	2725	1895	70%	450	17%	380	14%		
Viper 2014	2493	1637	66%	282	11%	574	23%		
Ulysses 2013	1673	920	55%	250	15%	503	30%		
Titan 2012	1229	904	74%	134	11%	191	16%		

Chart 2 shows the volume of the reduction of demand against the indicated time required to cease taking gas based on the responses given from the customers contacted. The target set by the NEC Safety Case Forum is to 'successfully deliver the instruction to reduce 90% of the available load within 2hours'. This was missed by 3%.

Chart 2 – Total LDZ Demand Reduction

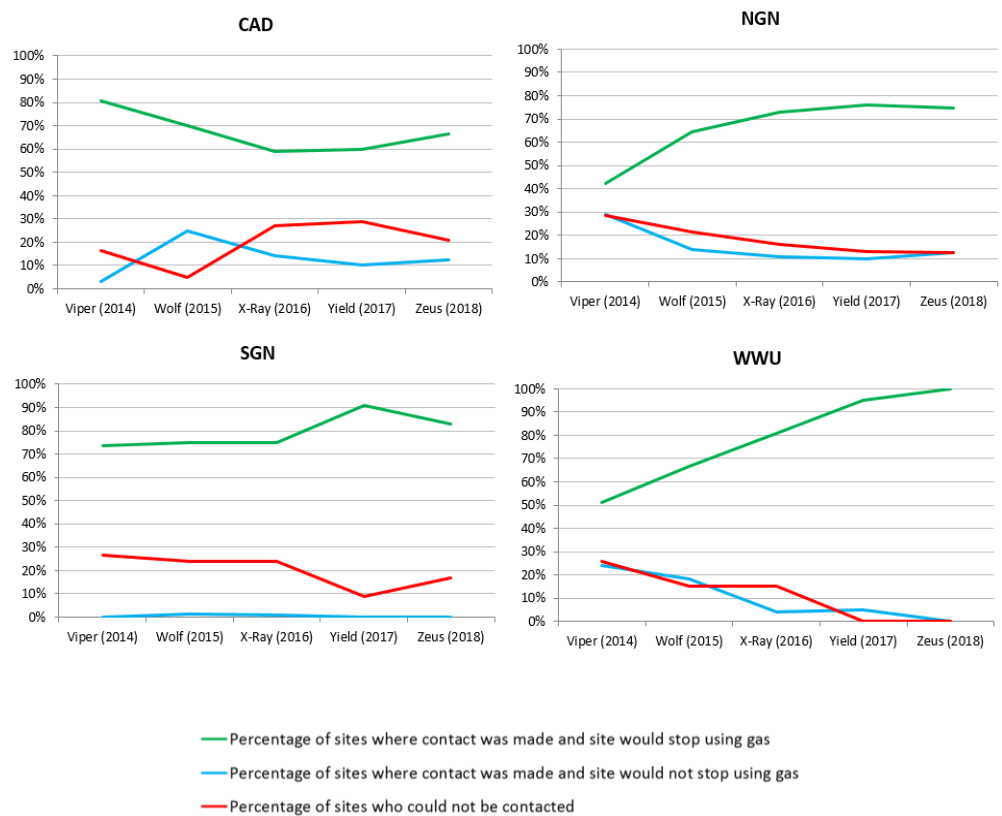


Disaggregating the data into the individual Distribution Networks, Chart 3 shows that two DNs achieved an improved result from 2017. WWU demonstrated the most successful set of results delivering 100% across all three tested criteria. Cadent has improved but are still below the 100% target with the lowest successful contact score. NGN's result is stable with a 1% reduction in sites which were contacted and would cease using gas. SGN however, had an 8% increase in sites which could not be contacted. A point of interest occurred in Cadent experiencing an increase in sites unwilling to cease taking gas.

Feedback obtained from the DNs outlined data quality to be a limiting factor in all DNs achieving the 100% target. As site data is gathered and input by the Shipper community, support from Shippers is required to improve this data. The DNs have taken an action to reach out to the Shipper community through the National Grid Operational Forum to help to improve this data.

Best practice sharing across the DNs through the E3 Alignment Group will continue across 2019.

Chart 3 – Comparison of DN firm load shedding performance



Summary

Table 6 presents an overall summary of the success of the load shedding element of Exercise Zeus. Though marginal gains have been made by the majority, there is still work to be done on the subject of load shedding to assure that NEC Safety Case Forum targets are met by all.

Table 6 – Success measure summary

Success measure	NG	Cadent	NGN	SGN	WWU
Number of sites where contact was made and site would stop using gas	91%	67%	75%	83%	100%
Number of sites where contact was made and site would not stop using gas	0%	12%	13%	0%	0%
Number of sites who could not be contacted	9%	21%	12%	17%	0%
NEC Safety Case Forum Target					Outcome
National grid to successfully deliver the instruction to reduce 90% of the available load within one hour					86%
Distribution Networks to successfully deliver the instruction to reduce 90% of the available load within 2hours'					87%

7 - Outcomes of objectives

This section considers each of the exercise objectives in turn and determines what assurance was obtained for each.

Objective 1: Ensure effective communication between Gas Transporters and with Regulatory and Government Departments

The consensus amongst Gas Transporters and BEIS was that communications worked effectively across Exercise Zeus. The simplified Situation Report introduced in Exercise Yield, again provided an effective method of consolidating situation reports.

NEMT responders responsible for compiling sit reps to BEIS commented that the pressure and challenge from BEIS did not resemble that experienced on the 1st March. It is assessed that this is due to exercise factors not replicating the pressures of real life. The E&IF team will work with BEIS to ensure that exercise conditions best reflect reality as closely as possible in 2019.

Objective 2: Test the upstream management procedure, web portal and emergency response communications

The OGA web portal which hosts the Gas Availability Status (G.A.S) report, used by terminals to share information on available supply with National Grid, was extensively tested during Exercise Zeus. A full write up of its continued value in a response is available in the preceding [Section 5.2](#).

Objective 3: Practice the response link between localised transmission and national supply emergencies

This objective was covered extensively by both the gas and electricity networks. The Network Gas Supply Emergency invoked load shedding and allocation and isolation actions on the Distribution Networks. As designed, the NGSE exercise reduced generation on the electricity network to such an extent that the electricity network was required to invoke load management protocols across the transmission and distribution networks. This is covered further in Objective 7.

Objective 4: Test the escalation and interaction between crisis management teams

The National Grid Crisis Management Team (CMT) was role played during Exercise Zeus. This allowed the NEMT's CMT Liaison position to prepare situation reports and receive simulated feedback replicating that which the CMT would seek if it were active. Being role played the CMT did not generate the same levels of pressure and feedback which would be expected for real. Participation in the next CMT exercise which utilises a gas incident scenario will therefore include the participation of a live NEMT to better 'pressure test' this element of the response.

Objective 5: Embed recommendations from previous industry emergency exercises including Exercise Yield (2017), and lessons learnt from the live events on the 1st and 2nd March (2018)

Many improvements have been made from Exercise Yield to Exercise Zeus, captured in [Appendix II](#). Most notable of these is the continuation of improved communications and interactions between the Distribution Networks and National Grid, brought about by a series of CTC exercises delivered in Q2 2018 and the continuation of the E3 Alignment Group. Further, the NEMT's enhanced

Briefing, Meeting, Working cycle, actioned as a learning from the response to the events of the 1st March, has brought a revised pace to the NEMT response allowing swifter contact with stakeholders and more timely sharing of situational awareness.

Objective 6: Validate emergency procedures, specifically E1, National Grid's E3, the E3 documents of the Distribution Networks and the NEC Safety Case

Each of the plans listed in this objective were rigorously tested during the exercise. Associated task cards and work instructions were utilised and will now be updated, following responder feedback, to make them as user friendly as possible.

The NEC Safety Case has recently been revised to Version 9. Version 9 of E1 will now be published containing updates arising from lessons learnt in the exercise.

Objective 7: Build on the current understanding of Electricity Industry interaction during a major gas event through expanded electricity sector engagement

The exercise extensively tested communications between the Gas and Electricity response. This highlighted the continued challenge in determining a common language and insight of each other's operational situation together with clarity as to legitimate information sharing.

National Grid will action to further enhance this response relationship through a series of knowledge sharing sessions, as described in learning point 3 in the preceding [Section 5.2](#).

Objective 8: Assure the effectiveness of communications between Gas Distribution Networks and HM Govt, with a focus on the local impact of national emergencies with regard to sites impacted and welfare arrangements arising

Applicable mainly to Emergency Stage 3, the communications between BEIS and the DNs were tested during a teleconference focused on the impact of isolation in the LDZs. This isolation element went further than has ever been tested and will form the basis of a restoration exercise in 2019. Further analysis of this objective is available in the preceding [Section 5.3](#).

Objective 9: Create a basis to deliver a restoration stage exercise at a later date

A detailed scenario and associated data is now available for continuation during a restoration exercise, thanks to the response during Exercise Zeus. The Gas Task Group has agreed to develop and deliver a restoration exercise in March 2019.

8 - Action areas

Based on observations and associated reporting, the five main action areas arising from Exercise Zeus are detailed in Table 8. These action areas should be reviewed and adopted by the E3 Alignment Group, managed by the National Grid Emergency and Incident Framework Team in their function as Office of the NEC. Progress will be reported to the NEC through the bi-annual assurance report, and in regular NEC liaison meetings.

Table 8 – Exercise Zeus action areas

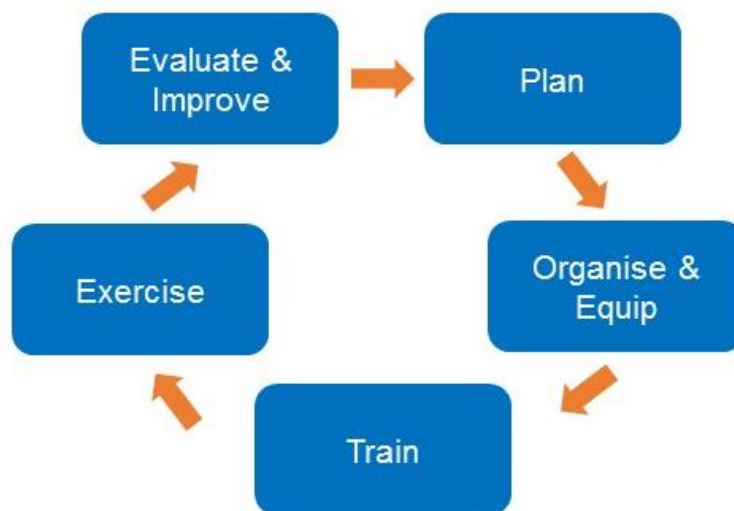
Action area	Next step
NEMT briefing meeting working cycle	The Emergency and Incident Framework Team will continue to 'pressure test' and further enhance the revised NEMT Briefing, Meeting, Working cycle through the 2019 exercise schedule. The process will also be shared with the DNs through the E3 Alignment Group for its potential benefit to the management of their response teams.
Electricity and Gas Interaction	National Grid Gas will work alongside colleagues in National Grid Electricity to further enhance a cross fuel understanding amongst responders of the respective silver level response teams. This will be achieved through knowledge share sessions and enhancements to communications process between the two teams, with specific focus on the load shedding of gas fired power stations directly connected to the NTS. Further, National Grid Gas will share the outcome of this action with BEIS for dissemination across their ERT responders.
Restoration	Through the Gas Task Group, the Emergency and Incident Framework Team will arrange an Industry Restoration (scenario based tabletop) exercise, which will be delivered by the end of 2019.
NEC briefings	The Emergency and Incident Framework Team will look to other industries with similar impartial representatives to adopt best practice as to how to enhance the briefings delivered to the NEC. Of specific focus will be methods for the provision of Situational Awareness and pro-forma for the organisation of briefings.
Determining figures in Emergency strategies	National Grid will lead, through the E3 Alignment Group, discussions to enhance understanding of the process DNs utilise to determine critical pressures and isolation values relevant in the face of emergency actions. The result of which will be to further develop the process for the NEMT's Demand Team to request data, with a view to developing a pre-incident understanding of these requests. This will in turn increase the speed of determining values associated with emergency actions. 2019's CTC exercises will be utilised as a basis to test revised processes.

9 - Feedback

The content of this post exercise report is based on a wide range of feedback gathered from all areas of participation in Exercise Zeus. The following methods were utilised to capture this feedback:

- **Exercise Directing Staff:** Members of the E&IF Team served as Directing Staff, in the NEMT Incident Room, across the expanded NEMT teams, and in all NEC briefings. This allowed direct observations to be compiled for inclusion in this report.
- **'Hot' wash up:** Each day of response culminated in a 'hot' wash debrief session, for the NEMT, to summarise the day's events and gather immediate feedback from participants and observers.
- **'Cold' debrief:** A formal debrief was held for the NEMT on the 17th October to gather considered feedback from across the disciplines of the team.
- **E3 Alignment Group:** An E3 Alignment Group meeting was held 18th October allowing the opportunity to gather feedback from the DNs and BEIS.
- **Industry survey:** An industry survey was issued on the 30th October to obtain an appreciation of the benefits of the exercise from across the industry. A line regarding the exercise has also been added to National Grid's Customer (C-SAT) and Stakeholder (S-SAT) satisfaction surveys.
- **Other sources:** The E&IF team instigated a number of discussions and informal methods of feedback with various other points of contact i.e. the OGA.

Figure 2 - Preparedness process



10 - Conclusions

Undertaking emergency exercises is central to assuring the NEC that the Gas Industry can effectively manage a NGSE and that it remains committed to continuous improvement of its safety critical emergency processes. The annual NEC Exercise is a requirement under the NEC Safety Case and GS(M)R, and remains a critical annual focal point for all UK Gas Industry participants to test their own emergency processes.

The objectives to test the industry's adherence to emergency procedures were successfully met with action areas for improvement developed from observations and feedback received.

The exercise gave appropriate assurance to the NEC that the industry can demonstrate that it is able to effectively respond to a Gas Deficit Network Gas Supply Emergency (NGSE) in accordance with the current emergency arrangements and protect the general public and the gas network.

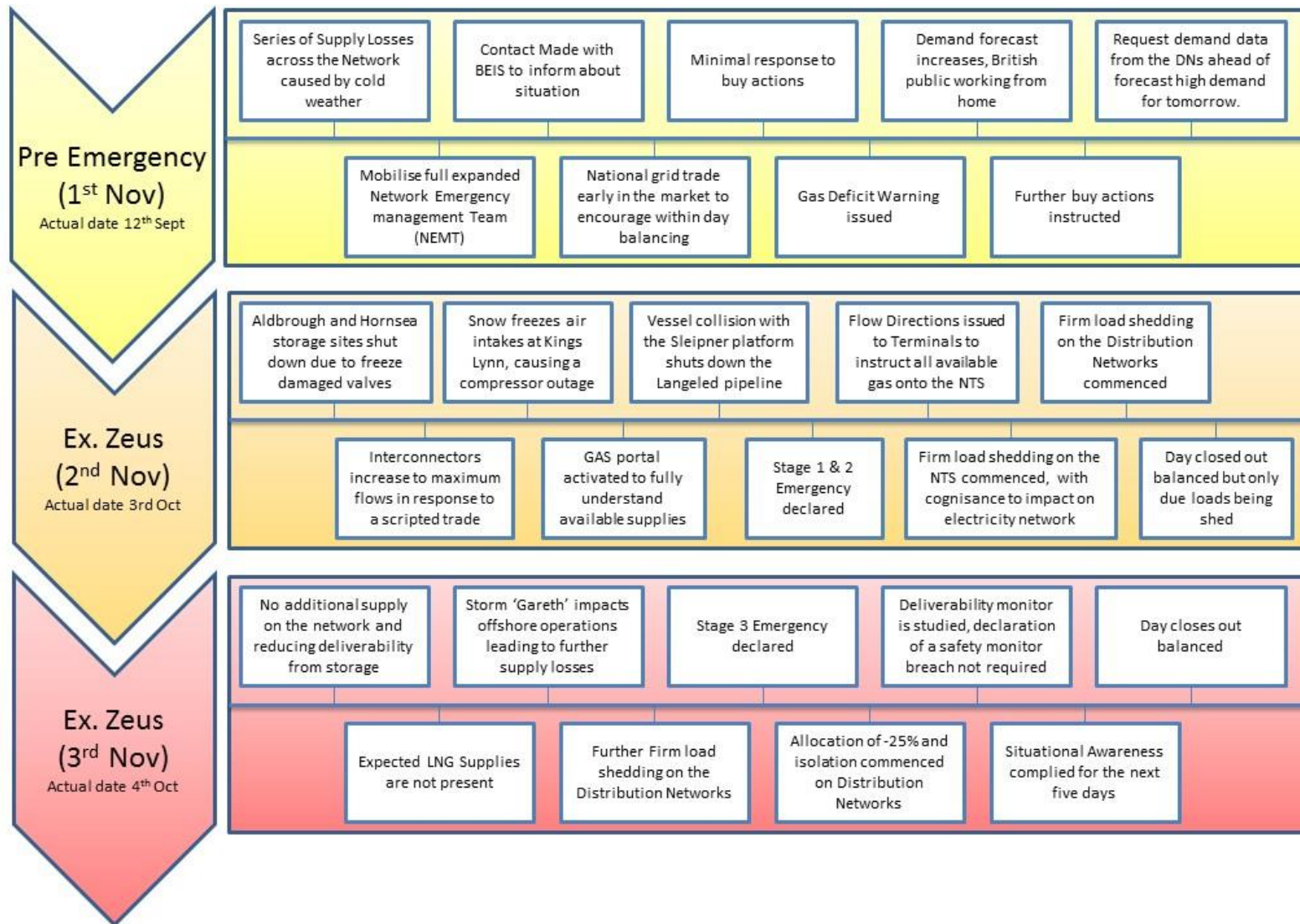
The exercise also provided valuable learning and experience to all parties; the improvements set out in this report will be delivered in 2019 and tested via the objectives to be set for the next NEC Industry Exercise.



A

Appendices

Appendix I – Timeline of events



Appendix II – Update on objectives from Exercise Yield

The following table details updates on the action areas raised following the 2017 NEC industry Exercise ‘Yield’.

Action area	Progress update
Engagement with Terminals and NTS directly Connected Sites	National Grid continued periodic customer liaison interactions across 2018. These had an enhanced focus on response following the events of the 1 st March. The commercial response in March also saw the live activation of the G.A.S Report which served as a focal point for interaction with terminals. Each NTS directly connected site received a communication check pre-exercise to assure arcuate communications channels were in place.
Communications	A focus on public appeals has been taken forward by E3C. Following delivery of 2018’s CTC exercises, communications between the NEMT and the respective response teams of the DNs has also received attention including the instruction to confirm all tasks communicated via telephone in writing and the delivery of a knowledge share on potential issues of the use of speaker phone during the E3 Alignment Group
Electricity and Gas Interaction	The Black Start Task Group continued across 2018. Further knowledge sharing sessions were held between National Grid Gas and Electricity, including live interactions on the 1 st March. National Grid Gas and Electricity also took part in BEIS’s Exercise ‘Noble Raccoon’ a preparatory exercise ahead of Exercise Zeus with a dual fuel focus. As detailed in preceding sections work will continue across 2019 to enhance these interactions.
Priority Customers	Training of all NEMT members was enhanced this year to include specific focus on the topic of priority customers. The topic received further, more detailed attention in Incident Controller, Demand Team and Supply Team training. All DN roadshows delivered in 2018 also focused on this topic as an area of education. Highlighting the topic of priority customers will continue in training throughout 2019.
Restoration	An exercise was delivered by arrangement between the DNs and IGEM in April 2018. This event was tabletop based leaving an opportunity to develop the findings of the conversations had into a simulated response. Through the Gas Task Group, National Grid will arrange an industry level restoration exercise. For delivery in 2019.

Appendix III – Glossary and References

BEIS	Department for Business Energy and Industrial Strategy
CTC	Critical Transportation Constraint
CAD	Cadent Gas
CMT	Crisis Management Team
DN	Distribution Network
DNCCs	Distribution Network Control Centres
E&IF	Emergency and Incident Framework Team (Gas Operations)
ENA	Energy Networks Association
ENCC	Electricity National Control Centre
ERT	Emergency Response Team
GDE	Gas Deficit Emergency
GDW	Gas Deficit Warning
GNCC	Gas National Control Centre
GNCC/E/3	Network Emergency Management Team's Emergency Procedure
GNI	Gas Networks Ireland
GS(M)R	Gas Safety (Management) Regulations 1996
HSE	Health and Safety Executive
IC	Incident Controller (NEMT)
kWh	Kilowatt-hour
LDZ	Local Distribution Zone
LGSE	Local Gas Supply Emergency
LNG	Liquefied Natural Gas
MCM	Million Cubic Metres
MJ/m ³	Mega Joules per Cubic Metre
NEC	Network Emergency Co-ordinator
NEMT	Network Emergency Management Team
NGN	Northern Gas Networks
NGSE	Network Gas Supply Emergency
NTS	National Transmission System
OCM	On-the-day Commodities Market
OGA	Oil and Gas Authority
OM	Operations Margins
PCLP	Predicted Closing Linepack
SAP	System Average Price
SOQ	System Offtake Quantity
T/PM/E/1	Procedure for Network Gas Supply Emergency
TFA	Terminal Flow Advisory (notice)
VLDMC	Very Large Daily Metered Customer
WWU	Wales & West Utilities

National Grid's Emergency Webpages:

<https://www.nationalgridgas.com/safety-and-emergencies/network-gas-supply-emergencies-ngse>

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