To:
The Planning Inspectorate

From:
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Re: Proposed CCS transmission pipework from Drax Power Station to primary storage compound at Camblesforth.

Summary

1. My objection is with regard to the routeing of the small diameter pipeline from the white rose project to the storage compound at Drax/Camblesforth. The route chosen is uncomfortably close to occupied dwellings (e.g. Woodlands, Main Road, Drax, and also Read School playing fields) where vulnerable persons are at risk if a failure of containment occurs in the pipeline. National Grid (NG) have stated that the risk of failure is an order of magnitude greater than the remainder of the pipeline which will lead to the coast. Other and safer routes exist that may have been considered, but claiming to be the shortest route (and thus lower cost), the cheapest option appears to have been settled upon by NG without ongoing consultation with the current residents. We (myself and Mr Alan Barker) would like the pipeline to be rerouted through a region where no-one will be at risk should a leakage occur, and where the leak would be detected early and stopped or minimised by use of suitable limiting devices.
2. My next observation is that whilst a degree of safety has been considered in designing and constructing the pipeline, the hazard ranges for the pipeline in daily use may have been underestimated, such that gross loss of containment may prove fatal for any persons exposed. The testing done at Spadeadam concentrated on immediate hazard zones, and not to realistic sustained leakage over a period of at least 30 minutes such that further damage to the pipeline would occur. The additional damage would propagate the fracture exposing a much larger area to the dense and suffocating cloud. I have considered the risk in some detail in this letter.
3. The project has been poorly publicised, and new occupiers of property such as myself and Mr Barker were not informed of the project when we bought our properties by our respective solicitors, as there is no legal requirement to do so. Any consultation that occurred with the previous occupiers has not been passed on, as they probably had no inkling of the safety implications. As new occupiers we therefore appear to have no say in the ongoing project, even though we are the ones affected by it. There are occasional minimal information newsletters and presentations, but these play the project

significance down, and in some cases give incorrect or misleading information. An example of this is the reaction between seawater in disused gas wells and carbon dioxide, where a very slow reaction (hundreds to thousands of years) occurs, and not the near instantaneous reaction implied by white rose.

4. A few other, possibly lower significance items are considered in this letter, including internal corrosion, flotation of the pipe (lack of anchoring), and toxicity of CO2.

Dear Sir(s),
I would like to bring to your attention some factors about the above proposal that I and my neighbour, Alan Barker of Woodlands, Main Road, Drax, have regarding the CO2 pipeline around Drax.

I have until recently been employed as a process safety and risk assessment specialist for over 21 years by the Health and Safety Executive.

I had a meeting with NG reps on 11th April 2014 at DRAX S&S club. The representatives were:
Mike Jordin – Senior Pipeline Roueting Engineer

Phil Knipe – Project Team Manager

Dr Jane Haswell – Principal Consulting Engineer

We discussed a number of concerns I had raised, and some of these responses have led to my observations below:

My particular concerns are with regard to the proposed 300mm id carbon steel pipeline section that will skirt the perimeter of Woodlands (the main house) at a distance of no less than 75 metres, and then less than 400 metres from the boundary of my own property.. The location of this section of the pipeline does not take into account that land occupied and owned by Mr Barker may be considered for his own future development, and the risk associated with occupation of such development would increase, as he would then be within the currently ‘defined’ high risk zone. Similar concerns exist for me (although to a lesser extent).

Toxicity:
Carbon dioxide is not currently classed as a toxic or very toxic substance, although HSE has advised that in liquid form such as in pipelines it should be considered a dangerous substance under the pipelines (etc) regulations. Their concerns are not currently in agreement with the reduced hazard zones proposed by National Grid and their advisors. Carbon dioxide is a poisonous gas in high concentrations as would be experienced around a loss of containment from any pipeline, but its toxicity is not currently supported by any major hazards regulations or enforcement.

Flotation

We are told that the pipeline will be buried beneath the surface soil to a depth of at least 1.2 metres. The area around Drax has a high water table (look in the farm drainage ditches), and if the pipe is empty, the water table may cause it to float with possible stress effects on joints and manufacturing weaknesses. I have experienced similar flotation scenarios with buried LPG installations that have resulted in pipeline rupture. There is no apparent system proposed to prevent flotation and subsequent exposure of the pipeline.

Risk assessment

We are told (no evidence provided) that the only real hazard scenario is pipeline failure from whatever cause, and that this is estimated at less than 0.3 x 10^-6 /km pipeline per year, that has not suffered internal or external erosion. The hazard range from such a failure has been derived from larger scale calculations on 600mm id lines, that yielded a reported range of 300 metres. As the pipeline diameter halved, the hazard range was quartered (?square laws?). I understand that the source terms are being compiled from experimental data, but are prone to error due to the atmospheric effects (humidity, temperature, wind speed) not being able to be incorporated. This leaves us with a set of raw data in which it appears we can have little trust unless additional safety factors are considered.

I have carried out a set of calculations using NOAA ALOHA, and a lower working pressure of 40barg (as the model does not support higher pressure flashing liquid escapes) and the model predicts a hazards range of 150 yards to a 5% CO2 concentration in the event of a leak using standard D5 parameters (typical daytime weather) over open countryside. At this concentration there is a significant risk of discomfort for those exposed, and at 10% there is a significant risk of death. The IDLH for CO2 is 4% in air. In my opinion, the hazard range should therefore be at least 150 yards from the actual pipeline.

I have no knowledge of any existing pipeline overland in the UK that currently operates at over 135 barg carrying an erosive and poisonous gas as a highly pressurised liquid, and would question the ability of National Grid (NG) at being able to safely carry out such transfers. They quote extensive experience with the transfer of high pressure natural gas, which I understand does not achieve these pressures, nor is it in the dense phase state of CO2. The only similar onshore pipeline (handling liquid hydrocarbon at extremely high pressures) that I have knowledge of is the ethylene pipeline from Grangemouth, via Teesside, Humberside and Mersey that may operate at similar pressures to CO2,, but is controlled and operated by commercial pipeline experts. This is an analogous substance only in that it is a pressurised gas above its critical pressure and transported at ambient temperatures.

I am not convinced that NG has either the experience or expertise to operate the CO2 pipeline safely given their current portfolio of energy transfer systems unless they employ personnel with that knowledge.

The risk assessment does not seem to consider that catastrophic rupture will result in the entire pipeline (between mechanical barriers) venting through the rupture point as anything but a totally atmospheric dispersionary event that will just be noisy but with minimal surface influence. I calculate that 3 metres of 600mm pipeline will contain a tonne of CO2, so 12 metres of 300mm pipe will also contain a tonne of CO2. The

length of the pipe is 5+ km, so approx 400 tonnes CO2 will be dumped at leak point, PLUS at least another 15 minutes production from the CCS plant (if the breach is detected). In discussion I was told that leak detection and stopping of CO2 input would typically take 30 minutes or so. I can only assume that this will be because of the relative remoteness of the pipeline to the production plant, and the reliance on the general public to raise any alarm.
The event will be a point release (Gaussian plume) with high but varying concentrations of a toxic (suffocating) and heavy gas that will drift with the wind. The plume will be cold and sink to ground level quickly, entraining water vapour (as ice) and high concentrations of CO2 that does not dissipate. At high release rates (volume not velocity) there will be increased concentrations of CO2 around the points of release.

I haven't calculated how long it will take to vent fully, but we can be certain it will take more than a few minutes, during which curious spectators and captive animals will be exposed to an invisible and deadly cloud of gas.

The IPCC report recommends that fracture traps should be placed at distances of 500m along the line to reduce the impact of pipeline failure, although NG advisors claim that a verbal communication from HSE at previous (informal?) discussions suggest that these traps are not required. The traps are not included in the final pipeline proposal. The inclusion of such traps would limit the release to more tolerable levels (as defined by HSE in R2P2)

I have discussed the 'verbal communication' with the named HSE inspector (a close colleague for many years), and he assures me that the traps were never discounted as being unneeded, but that the consultant was advised that other equally effective measures should be incorporated to provide a similar level of protection against uncontrolled release. In further discussions he mentioned the use of higher integrity (e.g. thicker) pipework and better distancing from vulnerable and static populations as well as considering early detection of leakage and faster response by appropriate means.

My initial calculations are that a release from the Drax 300mm pipeline would occupy a volume of 0.3 cubic km around the point of release at100% concentration regardless of air dispersion. We need to consider that an increase in CO2 concentration of only 4% in the air we breathe will cause injuries and death. What will happen at a release from the 600mm pipelines proposed to the coast?? There is NO additional safety measure proposed that will safeguard nearby property occupants from a larger drifting cloud! I suggest that the risk assessors should move away from the modelling to date that has been undertaken through COOLTRANS, and study worst case effects as predicted through hand calculations. They may then appreciate our concerns over the dimensions of the CO2 release and look closely at the historical deaths that have occurred.

I have read that the probability of failure of the first length of pipeline is 'very unlikely' and that the larger pipeline to the coast 'extremely unlikely'; putting this probability back into numbers equates to 1 in 1,000 for very unlikely, and 1 in 100,000 for extremely unlikely. This is not very comforting for the people around Drax. HSE's model of risk acceptability places the first category in the 'tolerable'

region of the ‘risk carrot’, although the level of risk would be expected to be reduced to a minimal value through affordable modifications, such as re-routeing or strengthening the pipeline. In my opinion risk of death at 1 in 1000 years is only tolerable if there are NO alternatives. Members of the public should typically be at risk of death at 1 in 1,000,000 years from an industrial activity –i.e. Broadly Acceptable. **The project, if it is to go ahead, should place the public at no significantly greater risk of exposure or death than if the risk was not present.**

The essential aim of any risk assessment is to reduce risk to negligible or zero levels; this is NOT being achieved through the NG proposals for a number of reasons, and the proposals should be halted until further risk reduction measures have been proposed, agreed and implemented within the final design.

Advice from the IPCC is that the pipeline should be constructed with fracture arresters and also high quality stainless steel if the CO2 is wet. There is an apparent system to purify the gas to tolerable limits for carbon steel in the white rose project. However, this is a novel process in the UK, and little experience is available to prove the chosen pipeline materials of construction are suitable at present. There are no proposed fracture arresters, apparently on incomplete verbal (not written) advice from HSE (as explored above).

In my professional and expert opinion: The recommendations of IPCC should stand in this novel project (as undertaken in the US) until and unless experience has proven otherwise. The US is NOT renowned for high performance when safety matters are considered, BUT the standards adopted by them at present appear higher than NG’s postulated methods in an unknown and unexploited method of corrosive and poisonous gas transfer.

Routeing

The route of the pipeline is a serious cause for concern. When we asked the pipeline installation engineer why it ran close to Woodlands boundary, we were told it was the shortest route, and chosen for no other reason. It seems strange that the shortest route is a combination of tight bends than result in a pipeline being more than twice the length of the more sensible shortest route, and that no other options such as routeing through uninhabited areas of the village have been considered. I showed the team a mirror image of the route passing through unoccupied land (using identical length) and was met with a blank response! When we asked if the route could be changed, we were told that that option could only be influenced by the Planning Inspectorate; hence our communication.
We know that there are safer pipeline routes around the village, and have shown them to National Grid representatives, with no response indicating their understanding or acknowledgement of our concerns.

Water in the pipeline during construction;

Pipelines will partially fill with water during construction through wet land, and the water (and products of hydration) will need to be removed prior to the commissioning of the pipeline to ensure optimum safe operation. IPCC recommends the use of stainless steel to avoid corrosion issues, but this has been dismissed by NG claiming

that they can operate the pipeline safely with virtually pure CO2, and 10 yearly pigging to determine weak spots.

Other considerations:
Industrial CO2 cylinders operate at 2-3000psig (135-200barg), and have a very thick (i.e20mm +) carbon steel shell. When they break, the fracture is normally along a faulty weld line, and extends the full length of the pipe section of which that the unit is made. At the points of release, the temperature of the pipe drops to-86C, which causes the metal to freeze and the fracture to propagate into adjacent structures, thus extending the length of the fracture and the area it will affect. Although this would limit the initial point release volume, it could increase the overall area of hazardous gas release; this could only be replicated through modelling.

Finally:
I have only considered a short length of pipeline between Drax and the first bulk storage point; How many similar transgressions are there in the pipeline to the coast?

Consultees to present have only been given speculative outcomes of probabilities of any releases, and not updated on uncertainties that remain, nor of lack of expertise in the field of compressed, poisonous gas transfer systems by NG. Smaller similar pipelines in industry handling liquid CO2 are subject to intense scrutiny and inspection by HSE. We are told that the UK Government has intervened in this matter to overrule HSE's recommendations for a high hazard classification for CO2 transfer, and as a result of the intervention many aspects of public safety have been ignored.

The proposed routing of the pipeline to the north and east of DRAX village places habitable property and a public school well within the hazard zones of dangerous substances that were not initially there. Regardless of the probability of leak (which can theoretically happen at any time, and NOT just 10 million years in the future), NG are introducing a toxic hazard, and thus reducing the appeal of property to prospective future buyers. Who would want to buy property immediately adjacent to a buried toxic hazard, and with a drop in property value, will individuals suffer as a consequence? Is there any plan to compensate owners for the loss in value of their properties or ability to develop on their own land? The hazards of industry are well managed within the confines of Drax power station, so placing an additional low risk (as determined by NG and its consultants) pipeline within the site boundary should cause no great problems for that site. Within the confines of the power station it should be easier to manage and maintain. Attempting to bury it in available farmland and adjacent to occupied property around the site is provocational.

The issue of ongoing consultation is open to question. Previous property owners were under no obligation to reveal the proposed pipeline to the new occupiers, and the views of the previous occupiers should have no bearing on what is being considered by NG. The newer occupiers appreciate the risks that accompany the proposals whereas the previous occupiers probably did not.

For a project such as this, there should be clear notification through a large notice board in any occupied area that the project could affect, and not the occasional mail-shot that is of dubious value in what it describes, plus a few very small laminated notices attached to sticks on the roadside.

I do not feel that NG or their advisors have acted competently or in the interests of the public in selecting the route for the pipeline in the first stage of the CCS pipeline project, and ask that their proposal is rejected or referred for further consultation.

I have also noted that Carbon Capture can be achieved more safely by reacting the CO2 with minerals and then using the carbonate salts in building materials, much as the SOx absorption units achieve at Drax. Why hasn't this been considered in a highly populated country like the UK instead of the more hazardous CCS project?

Yours Sincerely

Steve Harper
05/12/2014.