



Hinkley C Connection Project  
Consultation Response  
Freepost RRKX/EBGK/XXHT  
PO Box 5689  
London W1A 4 FG

5<sup>th</sup> January 2010

Dear Sir/Madam,

## **Consultation Response to National Grid Proposals for Hinkley Point C Connection Project**

Our response, based upon an independent report, suggests that an undersea route is no more expensive to provide than conventional overhead power lines. We suggest that the undersea route will save lives, reduce global warming, protect property values and safeguard local industry.

The Wraxall and Failand Parish Council have considered the implications of Grid's proposal by:

- Councillors attending the exhibitions and question the presenters.
- Physical examination of the actual routes through our parish.
- Listening to the residents concerns at public meetings.
- And commissioned an independent report, attached.

The Parish Council wishes to make it absolutely clear, that that there is considerable anger and total opposition to the either route especially as a better alternative is available. However, for the avoidance of doubt, the Parish Council, if forced to make a choice, totally rejects option 2 and would recommend option 1A.

We wish to support the power industry which is vital to the Nation but at the same time we suggest that the National Grid has:

- Failed to follow due process and so this planning application fails.
- Failed to provide expected current levels, (as of 29<sup>th</sup> December 2009).
- Provided misleading cost and engineering information.
- Not costed the health of the community subjected to electromagnetic fields.
- Not considered the property blight of the community subjected to pylons.
- Not considered the whole life cost to the Nation of HVAC transmission losses and maintenance.
- Not considered the environmental impact on the area or its impact on the tourist economy.

We understand that in this process, without IPC guidelines, there is no clarity as to the form our response may take or the necessity for the IPC to consider them. We will urge the IPC and politicians in this General Election year to take close scrutiny.

**Yours sincerely,**

**Chris Ambrose CEng  
Chairman**

Wraxall and Failand Parish Council

cc IPC, OFGEM, Minister of State, Dr. Liam Fox MP, Save our Valley

# **Report**

Commissioned by Wraxall and Failand Parish Council

On

## **Hinkley point C connection project**

*The National Grid's proposals for the erection of 400KV  
Transmission lines and associated pylons*

### **THE AMBROSE & PRATT REPORT**

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December 2009

## ABSTRACT

National Grid's proposed overland transmission is rejected on the grounds of visual impact, its contribution to Global Warming, risk to community, property blight and damage to local economy.

We agree with National Grid's Chief Executive<sup>11</sup> that undersea transmission "*is no more costly*" than overland and that an undersea grid is a "*no-brainer*"

In the absence of definitive facts from National Grid of their design, our opinion and our best estimates, recommend that:

*"Undersea transmission can reduce the Global Warming of National Grid's proposal by 50%, improve the environment and help meet Government 2020 targets to interconnect with other generators".*

*"A 20 yr savings could amount to over £1287m on a 60km transmission length. This has highlighted the National issue of transmission losses".*

We recommend that the Government should give:

- 1) National Grid tax incentives for the removal of existing overhead pylons and transmission lines.
- 2) A substantial prize, £500 million, to any UK company that demonstrates on a commercial scale the reduction of transmission losses to less than 0.2% for any transmission system costing less to install and operate than existing overhead pylons.

## Response to National Grid Proposals for Hinkley Point C Connection Project

### Contents

<b>LETTER TO NATIONAL GRID .....</b>	<b>0</b>
<b>ABSTRACT.....</b>	<b>1</b>
<b>EXECUTIVE SUMMARY.....</b>	<b>3</b>
APPENDIX 1 <b>KEY CORRESPONDENCE .....</b>	<b>8</b>
APPENDIX 2 <b>PLANNING.....</b>	<b>9</b>
APPENDIX 3 <b>ENGINEERING .....</b>	<b>17</b>
APPENDIX 4 <b>GLOBAL WARMING .....</b>	<b>25</b>
APPENDIX 5 <b>HEALTH ISSUES .....</b>	<b>28</b>
APPENDIX 6 <b>PROPERTY BLIGHT .....</b>	<b>30</b>
APPENDIX 7 <b>IMPACT ON TOURISM .....</b>	<b>33</b>
APPENDIX 8 <b>IMPACT ON VISUAL AMMENITY .....</b>	<b>35</b>
APPENDIX 9 <b>REFERENCES.....</b>	<b>37</b>
APPENDIX 10 <b>RESUMES .....</b>	<b>38</b>
APPENDIX 11 <b>DETAILED REPORT ON EFFECTS OF POWER LINES ON HUMANS .....</b>	<b>46</b>
APPENDIX 12 <b>KEY DOCUMENTS ACQUIRED.....</b>	<b>67</b>
APPENDIX 13 <b>DETAILED ENGINEERING CALCULATIONS.....</b>	<b>75</b>
APPENDIX 14 <b>TERMS OF REFERENCE .....</b>	<b>77</b>

## **EXECUTIVE SUMMARY**

### **Section 1 - Overview**

- 1.1.1 This report has been considerably scaled down and drafted in common language to make it accessible to all.
- 1.1.2 The Consultation<sup>23</sup> period has been too short and the information provided has often been misinformed and conflicting. It is still not comprehensive and ignores many related issues such as health, socio- economic impacts, and the environmental and visual impacts.
- 1.1.3 The undersea alternative is covered in the Strategic Optioneering Study<sup>31</sup>, issued in December 2009, but this was not part of the consultation alternatives.
- 1.1.4 We suggest that residents are being placed in an invidious position by National Grid with the choice being between two divisive options only. Residents will resist and challenge what is a limited and totally unpalatable proposal.
- 1.1.5 The Nation has a right to expect that the highest standard of performance will be demonstrated by the only public company licensed to transmit electricity. On this occasion it has been spectacularly lacking.
- 1.1.6 We request an extension of the timescale, proper and transparent consideration of all options and full and timely disclosure of requested materials.
- 1.1.7 Further, we submit that consideration should be given to a more fundamental delay in the process, to allow for the statutory consultation to take place effectively, and with adequate guidance from National government and with fully justified options made available.
- 1.1.8 “Misinformation is the enemy of sound judgment”. The decisions made now will have an impact for 50 years or more. We would like, therefore, both National Grid and ourselves to be better informed in detail about the alternatives, including whole life costs and indirect costs, so that the correct decisions are taken.
- 1.1.9 The current criterion for consideration is lowest overall capital cost, which we take to mean all upfront costs and therefore excludes cost associated with maintenance or transmission losses. It excludes all indirect costs from a socio-economic view point which would cover but not be limited to: reduction in

tourism revenue, devaluation of land values, devaluation in property values, and an increase in the costs incurred by the various health authorities.

1.1.10 We would also like to see the impact on our electricity bills of the various alternatives.

1.1.11 The National Grid as a publicly owned company has duties which conflict with its role as a licence holder to provide a public service.

1.1.12 Their financial duty is to provide for the benefit of the company and its shareholders, not the community.

1.1.13 The company is under constant pressure to meet quarterly projections for sales and profits. Thus there is no incentive to make decisions that benefit the longer term.

1.1.14 There is considerable "common sense" among "ordinary people" that living near a hazard, such as an overhead power line, is potentially hazardous and undesirable.

1.1.15 Whilst researching the data for this report, it became clear that an opportunity exists to make substantial, and long lasting savings, in terms of; money, energy and reduce the impact on the causes of Global Warming.

1.1.16 The potential savings of 1% over twenty years on 4500 miles<sup>9</sup> of national transmission losses in the UK could amount to £3,046 billion.

1.1.17 This opportunity we suggest needs an extra incentive. Technology is always emerging to meet need. This requires encouraging financially.

1.1.18 We suggest a two part approach. The first is to offer ongoing tax benefits to National Grid for the removal of Overhead pylons and Transmission lines.

1.1.19 The other is in the form of a substantial one off prize to any company operating in the Industry that demonstrates a specified level of improvement in the Transmission losses from HV cables.

1.1.20 The role that The National Grid plays in the lives of communities in the UK should recognize a duty :

1.1.20.1 To consider the consequences of each decision for the longer term.

1.1.20.2 To consider the impact their operations have on the community and the environment.

- 1.1.20.3 To maintain the highest standards of business conduct in their dealings with the public and their suppliers and clients.
- 1.1.20.4 To consider and comply with OFGEM<sup>2</sup> see Appendix 12.

## Section 2 - PLANNING

1.2.1 It is our submission that National Grid have:

- 1.2.1.1 Failed to give adequate consideration to the consultation process.
- 1.2.1.2 Failed to provide key documentation or information requests in a timely manner.
- 1.2.1.3 Failed to consider the impact of the lack of national policy or guidance on consultee ability to respond effectively.
- 1.2.1.4 Failed to provide correct technical information and have provided piecemeal reactionary responses which require additional consultation time to consider and respond.

## Section 3 - ENGINEERING

1.3.1 We suggest a total price of £661 million for provision of a High Voltage Direct Current, HVDC, Subsea transmission system.

1.3.2 Current Voltage-Sourced Converters, VSC, can instantly change the direction of power.

1.3.3 Multiple cables will allow for:

- 1.3.3.1 "Up scaling" or increasing capacity by adding cables as demand changes.
- 1.3.3.2 Ease of maintenance by taking one or more out of service, or even changing polarity of a cable, without significantly altering total transmission capability.
- 1.3.3.3 The ability to stage upfront costs by not installing total capacity until required.

## Section 4 – GLOBAL WARMING

- 1.4.1 We suggest that the proposed National Grid overhead power line:
  - 1.4.1.1 Increases effects of Global Warming more than 2 times that of our High Voltage Direct Current, HVDC, subsea design.
  - 1.4.1.2 Adds 129.6 MW to the effects of Global Warming.
  - 1.4.1.3 If this rate of loss is typical on all overhead power lines this loss would add 3% to all Electricity Bills.
- 1.4.2 We suggest that over twenty years a High Voltage Direct Current, HVDC, subsea design could save about £1287 million over the proposed National Grid proposal.
- 1.4.3 We suggest that on this criterion of Global Warming alone that this proposal from National Grid fails when compared with a High Voltage Direct Current, HVDC, subsea design.

## Section 5 – HEALTH ISSUES

- 1.5.1 There is a 100% certainty that exposure to sufficient radiation causes cancer.
- 1.5.2 Scientists have recognised a safe limit to the amount of exposure to a magnetic field humans should have as a result of their working or living conditions. It is possible that some people are exposed to above this, generally recognised limit, as a result of living near a power line.
- 1.5.3 It is also possible that other effects, currently being investigated by the Human Radiation Effects Group at Bristol University, contribute to the association between power lines and some human diseases.
- 1.5.4 The actual illnesses caused by radiation of an overhead power line may be increased by the long term internalised worry, stress or fear of living near an overhead power line.

## Section 6 – PROPERTY BLIGHT

- 1.6.1 The impact of new overhead transmission pylons can have on:

- 1.6.1.1 Agricultural land is to devalue by up to 15% from the sterilization of the corridor under the lines due to the requirements of the Health and Safety at Work Act, HASAW.
- 1.6.1.2 Land and property is to devalue by up to 15% even when only in the vicinity of transmission lines.
- 1.6.1.3 High value property when combined with location and view then this devaluation is higher and in some cases can become worthless and even unsaleable.

#### Section 7 – IMPACT ON TOURISM

- 1.7.1 There will be a contraction of the Local tourist Industry a replacement industry will be required.
- 1.7.2 Guidance from European Policy has not been followed.
- 1.7.3 Decisions are being taken which will damage local industries without study or costing.

#### Section 8 – VISUAL AMMENITY

- 1.8.1 Local landscape will be damaged irreparably. There can be no replacement benefit until they are removed.
- 1.8.2 Guidance from European Policy has not been followed.
- 1.8.3 Decisions are being taken which will damage local amenity without study or costing.

## **APPENDIX 1**

### **KEY CORRESPONDENCE**

#### **Section 1 - Received**

- 2.1.1 "Hinkley Point C Connection Project" – National Grid. October 2009
- 2.1.2 "Hinkley Point C Connection frequently asked questions (FAQs) – National Grid. 2009

#### **Section 2 – Acquired – see Appendix**

- 2.2.1 "Letter to Dr. Liam Fox" – David Mercer of National Grid. 16 Dec 2009
- 2.2.2 "Email to Chris Ambrose" - David Hunt of OFGEM. 27<sup>th</sup> Nov 2009
- 2.2.3 "The Business Interview"– Sarah Arnott for The Independent. July 23<sup>rd</sup> 2009

## APPENDIX 2

### PLANNING

#### Section 1 – Planning Process Issues

- 2.1.3 The statutory process for consultation as required under the 2008 Act requires that National Grid provide a Statement of Community Consultation<sup>21</sup>, SOCC, to relevant Local Authorities for review and agreement, so that local ideas on how the consultation should be carried out are integral to the process.
- 2.1.4 North Somerset Council has agreed the Statement of Community Consultation, SOCC, content provided to them in the absence of any guidance.
- 2.1.5 The Statement of Community Consultation, SOCC, requires that sufficient information be provided to allow for proper and meaningful consultation with the public and statutory consultees, such as the relevant Local Authority.
- 2.1.6 This response has been developed on behalf of the community of Wraxall and Failand, to ensure all relevant issues are considered fully in order to meet the statutory aim, and to point out areas of concern requiring further investigation so that any future application to the Infrastructure Planning Committee, IPC, is made with all relevant factors considered.

#### Section 2 – Consultation Issues

- 2.2.1 This submission concludes that the consultation is defective and cannot therefore adequately consider the views of the Community via the appropriate statutory process. It is flawed to such an extent to suggest that it may be considered unlawful, and is certainly premature in its conclusions and the options provided.
- 2.2.2 It is submitted that **the Consultation has failed in the following areas:**

##### **2.2.2.1 Nationally**

- 2.2.2.1.1 In the absence of guidance from National Government on the levels of involvement, the relevant Local Authority has stated they are unable to produce a Local Impact Report, LIR, as required.
- 2.2.2.1.2 This statutory requirement cannot therefore be met due to the prematurity of the commencement of the consultation period. However we understand from minuted decisions taken at North Somerset Council in relation to the proposal that the Council oppose the options put forward, would prefer the alternatives are properly considered before continuation of the process and have only indicated a preference for one route over the other on the basis these are the only options available. There are no statutory provisions which allow for the Council to submit this information.
- 2.2.2.1.3 The importance of the Local Impact Report, LIR cannot be underestimated in the process, given the lack of local authority input to the decision.

- 2.2.2.1.4 The relevant National Policy Statement on energy determining how the decision will be taken by the IPC, and the criteria they will apply when determining an application, has not yet been adopted. Members of the public are being asked to give their views on a project with far reaching and long term effects without appropriate guidance or information.
- 2.2.2.1.5 It is only from reviewing information on which matters the National Grid must consider in their determination of options (eg. Environmental impacts, area designations etc) that it will be apparent whether National Grid are compliant in the manner in which the options have been selected for consultation. For example; the requirement to provide a lifecycle costs analysis, balancing impact with cost considerations, set out in the EASAC document<sup>25</sup> entitled “Transforming Europe’s Electricity Supply- An infrastructure strategy for a reliable, renewable and secure power system” has not been addressed in this application, but as there is no clarity as to whether this will be required by policy, submissions on failure to provide cannot be made.

#### **2.2.2.2 Locally**

- 2.2.2.2.1 The initial letter sent to members of the public allowed for a period from 1<sup>st</sup> October 09 to 8<sup>th</sup> January 10 for initial consultation as set out in the. Statement of Community Consultation, SOCC. This was received by a selected number of residents thought to be affected directly by the proposals, when it should have been recognized that everyone within the region will be affected to varying degrees by these dramatic proposals.
- 2.2.2.2.2 The process was flawed from the start in that the letter made reference to details of a public exhibition programme.
- 2.2.2.2.3 This programme failed to include the villages of Wraxall and Failand as ~~venues~~, despite the proposal including pylons directly through these villages. The neighbouring town of Nailsea, which forms one of the strategically recognised four main towns of the North Somerset Area within the Local Authority Local Plan, with a population of circa 21,000 people, was also ignored in the programme. T
- 2.2.2.2.4 This was rectified following pressure from the residents and our MP, Dr Liam Fox, and an exhibition was held on Thursday 26<sup>th</sup> November hosted by National Grid followed by a public meeting on Friday 27<sup>th</sup> November called by a resident's action group to address the proposals put forward.
- 2.2.2.2.5 This had the effect of reducing the timescale for members of the public in these areas to be able to respond or consider any response they would wish to make. As information was unavailable until late in the consultation process.
- 2.2.2.2.6 It is considered that time for any consultation (let alone a major undertaking covering great swathes of the South West) should be sufficient and in this case it is not considered to have been adequate.
- 2.2.2.2.7 With the Christmas period removing approximately two weeks from the available time to respond, the timescale is made more difficult.

- 2.2.2.2.8 This is perceived as a deliberate ploy to reduce opposition. We request a more reasonable time table with an extension to consider the issues raised at this late stage.
- 2.2.2.2.9 One outcome of the Nailsea Consultation Meeting was the concern that National Grid had failed to adequately consider all options as part of reaching a decision on the proposal to bring forward.
- 2.2.2.2.10 In particular, the fact that only overhead line proposals were being made and no consideration of alternative methodologies for transmission was included such as subsea or undergrounding.
- 2.2.2.2.11 This approach was challenged at the meeting on 27<sup>th</sup> November 09 and in early December (Wraxall and Failand Parish Council received a copy 10 12 09) a “Strategic Optioneering Report”<sup>31</sup> was issued via their web site.
- 2.2.2.2.12 This set out the way in which National Grid had arrived at the two options now being consulted upon.
- 2.2.2.2.13 It is submitted that additional consultation time is required to properly assess this new document, as it covers key aspects of the proposal, requires in depth study by relevant specialists, and is fundamental to whether the opinions of the community on the methodology to be employed will be re-considered.
- 2.2.2.2.14 The fact that this document, vital to the consultation process, was not made available until such a late stage in the consultation process shows a disregard for the process and implies unwillingness on behalf of National Grid to be open and transparent in the decision-making process.
- 2.2.2.2.15 There are numerous issues requiring a response including clear errors and misinformation which require full assessment.
- 2.2.2.2.16 The initial contact with residents was by way of a mail drop.
- 2.2.2.2.17 This was received by a selected number of residents thought to be affected directly by the proposals, when it should have been recognized that everyone within the region will be affected to varying degrees by these dramatic proposals. Important commercial tourism is dependent on the beauty of the area would require information and time to be advised and respond.
- 2.2.2.2.18 This mail drop was itself flawed, as the letters were addressed to the “Occupier” and appeared to be “junk mail”. Many recipients have reported immediate recycling. For those on the “do not allow junk mail” register, the letter was never received.
- 2.2.2.2.19 Anecdotal evidence supports the fact that many of those recipients failed to recognize the significance of the letter and either ignored it or contacted their energy supplier, EDF, who vaguely suggested it was probably a local upgrade.

### **2.2.2.3 Technically**

- 2.2.2.3.1 We suggest from an initial review that the consultation process has exposed that a number of errors and technical misinformation have been circulated to the public. An initial review of the documentation by our retained expert concludes that in particular;

2.2.2.3.2 Consultation originally suggested a "feed only" or one way supply from Hinkley. Following concerted efforts to ensure extended consultation due to the failure to include Nailsea, residents were informed this was now considered part of a new Grid system being required contractually (27 /11/09).

2.2.2.3.3 When requested National Grid was unable to provide basic information about current levels<sup>24</sup> in a timely manner despite assuring the public certain options were unavailable due to current requirements<sup>31</sup>.

2.2.2.3.4 Further, National Grid suggested on 27/11/09 that: Undersea technology is unproven despite owning the HVDC link to France, that Undersea technology is unproven despite HVDC undersea technology being available since 1897<sup>29</sup> and that HVDC cannot be instantly reversed which is not true and also irrelevant.

### Section 3 – Environmental /Socio-economical impacts

- 2.3.1 At present there is no information about the environmental impacts of the proposed overhead routes other than an acceptance that National Grid has a policy in relation to protection of certain designated areas such as, Areas of Outstanding Natural Beauty, AONB, by undergrounding.
- 2.3.2 In other words there is an assumption underlying the application by National Grid that a costs analysis determines the methodology – i.e. overhead lines are cheapest - unless there are specific designations to adhere to in landscape terms.
- 2.3.3 This recognises what was already stated publicly on 26 November; that the analysis has so far been conducted by a desk top review with no consideration of the landscape merits. Full landscape assessment should include the Mendip Hills AONB and the Levels of Somerset but should also take account of the various smaller scale Landscape Character Assessments available within current planning guidance at the Local Planning Authorities for the relevant area.
- 2.3.4 These strategic documents must be adhered to by all other applicants for permission to develop land and should be material considerations both at the options and at the assessment of those options stages. It should also be added that there are other important designations affected by the route – in particular the setting of Tyntesfield - a Historic Park and Garden and a Grade 1 listed building but no mention is made of the consideration of protection of this historically valuable landscape or the usual protections afforded to Green Belt areas or The Forest of Avon (through which the proposed routes pass).
- 2.3.5 Although National Grid state publicly that they consider all aspects of a proposal and include reference to the natural environment, cultural heritage etc we see no evidence that any of these have been considered in formulating these proposals.
- 2.3.6 Although there is mention in the National Grid website of the need for future environmental impacts to be managed through the Environmental Impact Assessment, EIA process once the actual route is chosen.
- 2.3.7 This pre-supposes the acceptability of at least one of the options put forward in environmental terms.

- 2.3.8 However, we submit that the environmental impact of proposals should be key in the option determination process otherwise it provides the ability for proposals to discount options at an early stage forcing the IPC to choose the lesser of two evils, as presented, rather than a comprehensive consideration of the alternatives actually available.
- 2.3.9 For this proposal it is asserted that there should have been comprehensive consideration of undergrounding and /or subsea proposals.
- 2.3.10 The late availability of the optioneering report detailing the purported consideration of these other options, its creation as part of the project retrospectively and the fact it follows a basic model for project management rather than any comprehensive reviews does not meet the standards expected for a nationally important project.
- 2.3.11 No mention of the extent of the works to ensure protection for vulnerable areas or costing of the underground route, were it to be intermittently provided, have been provided in the consultation.
- 2.3.12 However, the National Grid have been quick to provide spurious approximate pricings in the optioneering report that justify deciding not to take certain options forward.
- 2.3.13 We have prepared a detailed alternative costing to demonstrate the incorrect particulars provided by the proposer at this time to justify their options.
- 2.3.14 It is clear on an initial reading however that environmental impacts have not been properly considered and the costs of construction and installation have been the key issues.
- 2.3.15 When the real costs of the proposals are weighed up under the Environmental Impact Assessment, EIA, Regulations and the proposer has to justify why other alternatives were not considered it is our view that the proposal will be lacking and the subsea option will be more viable than overground.

#### Section 4 - Substantive objections to the scheme(s) proposed

- 2.4.1 At present there are two options proposed – both rely on the erection of overhead cables on 400kv pylons across the majority of the length – but they take slightly different routes around the conurbation of Nailsea.
- 2.4.2 The Key objections are that;
  - 2.4.2.1 The proposal will have an unacceptable impact on the landscape quality of the proposed route and will affect multiple areas that require protection, including those areas normally protected under standard planning legislation such as Green Belt, Listed building settings, Historic sites etc.
  - 2.4.2.2 The proposal is to supply energy for the public good and the IPC is required to consider overruling other statutory protections on that basis yet there has been no consideration of the public impact or socio-economic criteria in determining the options proposed nor is there substantive evidence these have been considered for the routes proposed.
  - 2.4.2.3 There is a lack of information about the proposal for those affected to be able to prepare adequate consultation responses.
  - 2.4.2.4 There is insufficient information on the health problems from the placing of the route directly adjacent to a primary school.
  - 2.4.2.5 Although there is a statutory requirement in relation to Areas of Outstanding Natural Beauty, AONB, under the Countryside and Wildlife Act 2003 (s.85) and

it is therefore conceded that certain aspects of the line will need to be undergrounded it does not appear that this will be clarified at this stage in the process.

## Section 5 – The Connection Project and its present proposal – Commentary

- 2.5.1 Referring to the National Grid Communities Relations Team leaflet (A5 folded) Hinkley Point C Connection Project; dated October 2009.
- 2.5.2 This provides in its simplest terms the rationale for the present proposal and states;
  - 2.5.2.1 "We will need to build a 400KV overhead line linking Bridgwater and Seabank (Avonmouth) substations. This connection has been identified as the most efficient and economic way to accommodate the additional power from Hinkley Point C".
  - 2.5.2.2 "This route will also be essential to help connect other power generation facilities which are planned in the area and will help the Government meet its renewable energy targets by 2020"
  - 2.5.2.3 It goes on to describe two broad route corridor options for the new overhead line;
  - 2.5.2.4 "A route corridor is a broad width of land within which a new overhead line could be routed and therefore it is often much wider than the actual amount of land needed for a new overhead line".
  - 2.5.2.5 "National Grid has undertaken extensive studies to identify these broad route corridor options"
  - 2.5.2.6 "When identifying a route corridor option, we work to reduce the impact on local communities and the environment. We take into account current legislation and guidance, and views of statutory consultees such as Natural England, English heritage and local authorities".
  - 2.5.2.7 It then describes the two corridor routes;
  - 2.5.2.8 Corridor 1; "Two potential options have been identified in this corridor. The first would be to decommission the existing 132KV overhead electricity line (owned by the distribution network operator – Western Power Distribution, WPD) that runs between Bridgwater and Seabank and adopt the same route for the 400KV overhead line".
  - 2.5.2.9 "The second option is to keep the existing 132KV overhead line and build our proposed 400KV overhead line in Parallel".
  - 2.5.2.10 Corridor 2; "Corridor two is slightly more complicated as it contains different options within it". .....etc.
  - 2.5.2.11 Until it states; "All three of these possible corridors converge again north east of Weston- super- mare and carry on to the east of Nailsea before rejoining the existing 132KV overhead line near Portishead and on to Seabank".
- 2.5.3 The meaning conveyed by these statements implies that;
  - 2.5.3.1 The decision to use overhead lines has already been made.
  - 2.5.3.2 The only decision to be made is the route.
  - 2.5.3.3 That the impact on local communities and the environment will only be undertaken once a commitment to a route is made.

- 2.5.3.4 That the detailed views of statutory consultees will only be undertaken once a commitment to a route is made.
- 2.5.4 The above is therefore highly significant, in that, the implications of National Grid's statements and the consequences of their actions are irreconcilable.
- 2.5.5 National Grid demonstrated in "Hinkley C Route Corridor Study Executive Summary" their awareness of the environmental constraints and influences, particularized in "Conclusions" were they state;
- 2.5.5.1 "Overall Corridor 1 (option 1A) is considered the least environmentally constrained corridor as it uses the route of the existing 132KV overhead line which will be removed and will not result in any additional overhead lines in the landscape".
- 2.5.5.2 "Corridor 2 is considered to be more environmentally constrained than Corridor 1 primarily due to the effect on landscape and amenity....."
- 2.5.5.3 "Corridor 1( option B) is considered to be the most environmentally constrained corridor as it would result in a new 400KV line closely aligned to the existing 132KV line for the entirety of its route.."
- 2.5.6 The foregoing suggests that, rather than just requesting initial responses and raising awareness with key stakeholders, National Grid should have recognized, and had commissioned, before any public consultation, and at the very least, detailed reports on the impact on local communities from the proposals, an Environmental Impact Assessment, or Consideration should have been given to Landscape Character Assessments and detailed explanations given as to why the amenity impact identified is considered to be outweighed by the proposal need.
- 2.5.7 National Grid should also have had in place a contract with Western Power Distribution, WPD as the owner of the distribution lines that it wishes to replace in order to demonstrate need for the proposal.
- 2.5.8 These studies would have identified many of the issues raised in this report and caused a rethink of the approach National Grid where taking.
- 2.5.9 A further matter is the reference made to renewable energy generation in their statement;
- 2.5.10 "This route is essential to connect other power generation facilities which are planned for the area".
- 2.5.11 As far as we are aware, the only renewable power generation being proposed is to be located in the Estuary and Bristol Channel, and is potentially either to be wind farms, wave energy generation, a barrage or a series of lagoons or a combination of all these. The time line suggested is operational by 2030.
- 2.5.12 However, National Grid's inference is that there are proposals for power generation facilities along the route of the overhead lines, presumably wind farms for which no proposals or draft proposals are available.
- 2.5.13 Wraxall and Failand Parish Council is surprised by this revelation as it has no knowledge of this intention.

## Section 6 – Conclusions

2.6.1 It is therefore the case that National Grid have:

2.6.1.1 Failed to give adequate consideration to the consultation process.

- 2.6.1.2 Failed to provide key documentation or information in a timely manner.
- 2.6.1.3 Failed to consider the impact of the lack of national policy or guidance on consultee ability to respond effectively.
- 2.6.1.4 Failed to provide correct technical information and have provided piecemeal reactionary responses that require additional consultation time to consider and respond to them.
- 2.6.2 We request an extension of the timescale, proper and transparent consideration of all options and full and timely disclosure of requested materials.
- 2.6.3 Further, we submit that consideration should be given to a more fundamental delay in the process to allow for the statutory consultation to take place effectively and with adequate guidance from National government with fully justified options made available.

## APPENDIX 3

### ENGINEERING

#### Section 1 – The Problem

- 3.1.1 The Consultation document<sup>23</sup> issued to residents identified connecting a 3600 MW, 3.6GW, Nuclear Generator at Hinkley to the network by running a 400,000 volt, 400kV, line.
- 3.1.2 What is unclear is where this power is to be used.
- 3.1.3 On 31<sup>st</sup> December 2009 we were informed<sup>24</sup> that the expected current would be 3000 to 3900A in the 400,000 volt, 400kV, line.
- 3.1.4 What has been finally released<sup>4</sup> is a requirement for a 4000MW, 400GW transmission system.

#### Section 2 – National Grid's Solution

- 3.2.1 National Grid have offered only a conventional overhead pylon with 18 conductors with an expected operating temperature<sup>25</sup> of 95°C
- 3.2.2 National Grid expect<sup>4</sup> to pay £656million to provide a 60km line<sup>23</sup>.
- 3.2.3 National Grid have not provided any life costing, such as maintenance or transmission losses, nor have they included in their costing any other issues such as health, property blight, loss of tourism or global warming.
- 3.2.4 National Grid's Strategic Optioneering Report, SOR, seeks to address its needs and wants in a structured approach.
- 3.2.5 This is an approach used in the electrical industry and other forums, to make decisions between equally good alternatives as well as satisfy competing objectives. It is unfortunately a methodology that is readily manipulated by establishing constraints and by coarse screening of options, and the application of scoring and weighting criteria, leaving the decision maker to select the best way forward. This suggests that the outcome is prejudged.
- 3.2.6 The better approach to arriving at an agreed solution is to undertake a feasibility study that ensures that a thorough knowledge and understanding of all the issues related to the project from all stakeholders is undertaken to ensure the delivery of a robust study. Each alternative, and each risk is identified, detailed information is gathered and each receives an in depth assessment.
- 3.2.7 This approach will increase financial certainty, identify risks that can then be better understood and quantified, and help to avoid expensive mistakes. It is by its very nature, therefore open and transparent.
- 3.2.8 We suggest that National Grid's Strategic Optioneering Report, SOR in the following areas fails because:
  - 3.2.8.1 This proposal, and therefore the decision, is a “desk top” study and therefore it has limitations.
  - 3.2.8.2 There is no explanation how these short comings will be dealt with.

- 3.2.8.3 There is no a visual or character impact assessment which is required under its obligations.
  - 3.2.8.4 There is no socio economic assessment. This is an extremely important consideration in an area strongly reliant on tourism.
  - 3.2.8.5 There is no recognition that one of the options is not under their control but rather belongs to a separate company with whom National Grid have to establish a legal contract. Hence it is premature and presumptuous to include such an option.
  - 3.2.8.6 There is no consideration of the use of HVDC cables overland, a possible solution that could provide transmission benefits.
  - 3.2.8.7 There is no explanation of the criteria for reliability for the different alternatives and hence the impact on cost.
  - 3.2.8.8 There are no weightings for each consideration.
  - 3.2.8.9 There is no mention of which converter technology National Grid are considering.
  - 3.2.8.10 There is no mention of which type of cables National Grid are considering.
  - 3.2.8.11 There is no consideration of the transmission losses for the different systems. This has a cost penalty.
  - 3.2.8.12 Their technical viability of subsea systems is out of date.
- 3.2.9 National Grid have rejected subsea as being:
- 3.2.9.1 12 to 14 times more expensive than conventional overhead pylon<sup>26</sup>.
  - 3.2.9.2 An unproven technology<sup>27</sup>.
  - 3.2.9.3 Unable to instantly reverse current<sup>27</sup>.

### Section 3 – Transmission of Power

- 3.3.1 Power can be transmitted in two forms of electricity Alternating Current, AC, or Direct Current, DC.
- 3.3.2 The choice of form of electricity chosen depends on many factors which appear to be baffling with competing benefits depending on how one views our Nation's future<sup>28</sup>.
- 3.3.3 National Grid has offered Alternating Current so we have sought to explain their reasons so that the benefits of our alternative suggestion can be contrasted.
- 3.3.4 In Alternating Current, AC, the movement (or flow) of electric charge periodically reverses direction. An electric charge would for instance move forward, then backward, then forward, then backward, over and over again. In Direct Current, DC, the movement (or flow) of electric charge is only in one direction. This is shown in fig 1

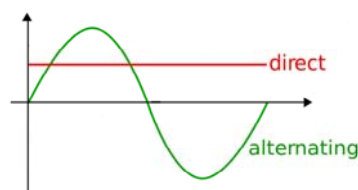


Fig 1

- 3.3.5 Any voltage over 1000 volts, 1kV, is termed High Voltage so we now see transmission not as AC or DC but as HVAC or HVDC.
- 3.3.6 The transmission of power can at present be provided by cables which are either suspended in the air, under ground or under the sea.
- 3.3.7 As the cables must be insulated from the other cables, the ground and humans, they must be provided with suitable insulation or suspended well out of reach.
- 3.3.8 With overhead pylons the cables are suspended on insulators from the pylon towers and well out of reach from the ground at the lowest point. There are internationally approved distances that the lowest point can reach from the ground so that "normal life" and traffic can travel underneath.
- 3.3.9 The pylons have also to be large enough to prevent cables from coming too close to each other due to sway in the wind.
- 3.3.10 The cable sags due to its own weight and due to expansion caused by the cabled running at 95°C. This is hot enough, almost, to boil water.
- 3.3.11 At 400,000 volts, 400kV, the electricity can jump, or arc, about 15 cm in dry conditions; however once it has jumped it will take a greater distance to break, or stop, the flow of current. This break distance may be 3 to 5 m.
- 3.3.12 The cables are suspended by insulators which are made of ceramic or polymer material which are not as good insulators as air. At 400,000 volts, 400kV, the insulators would typically be 3.5m overall with a surface length of 12m. It is the length of surface the voltage has to "flow" which is the controlling factor typically 30mm/kV.
- 3.3.13 These factors and distances control the height, width and spacing of the pylons. In this case National Grid has proposed 46.5m towers at 365m centres<sup>28</sup>.

#### Section 4 – Underground/undersea cables

- 3.4.1 Cables which are underground, or under the sea, have because of their location to be provided with insulation which encases the actual cable.
- 3.4.2 This insulation can be typically in two forms<sup>36</sup>. The first is where the conducting cable is held away from the outer cover by Cross Linked Polyethylene, XPLE, fig 2. These Cross Linked Polyethylene cables, XPLE, are sometimes referred to as polymer cables. The second where the cable is in oil pressurised paper called Mass Impregnated, MI, fig 3.



Fig 2

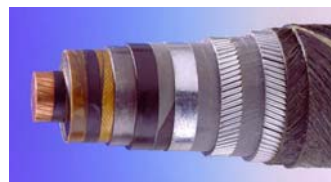


fig 3

- 3.4.3 The insulation and covering geometry and relative sizes will depend on the type and voltage of electricity, Alternating or Direct Voltage, its location and physical loads the cable will experience when being installed and during its operational life.

- 3.4.4 The size of the conductor will depend on the current, measured in Amperes, A, being carried and will typically require 0.8 square mm of area for each Ampere, A, of current.
- 3.4.5 If a higher current, or voltage, level is required then several conductors are used in parallel being laid about 15m to 50m apart to simplify maintenance.
- 3.4.6 Cables can be laid in subsea trenches which are excavated with high pressure water jet.
- 3.4.7 We suggest that a subsea High Voltage Direct Current, HVDC, system with lower cable losses is used as it will be more flexible to the demands of the government renewable energy demands<sup>28</sup> and is a more proven system than subsea High Voltage Alternating Current, HVAC.
- 3.4.8 High Voltage Direct Current, HVDC, cables have been available since 1897<sup>29</sup> and is a mature industry with several major suppliers for example:
  - 3.4.8.1 ABB Power Technologies AB
  - 3.4.8.2 Prysmian Cable and Systems Ltd
  - 3.4.8.3 Okonite Inc.
  - 3.4.8.4 Nexans Cabling Solutions UK
- 3.4.9 Another form of cable conductors are super conductors. These cables are cooled to a near  $-273^{\circ}\text{C}$ , which is absolute zero. These cables exhibit almost no transmission losses but have the complexity of having to be cooled.
- 3.4.10 There is only one operational installation, in USA, which is being monitored. In our study we decided not to develop a design as this is leading edge technology.

Section 5 – The laying of cable

- 3.5.1 Cable which is being placed underground requires a trench to be cut, or tunnel made, in which the cable is laid or carried.
- 3.5.2 Our suggestion for the subsea cable is that the cable is not tunnelled in the sea bed but laid by a ship or barge, fig 4 & 5



Fig 4



fig 5

- 3.5.3 There has been considerable experience of this type of work with the proliferation of offshore wind farms and electrifying of swamp areas in Africa.
- 3.5.4 Cable laying vessels are readily available for hire or purchase with drum capacities in excess of 50 miles of 75mm cable. If a longer cable is required jointing can be achieved at sea.
- 3.5.5 Cable laying has been available and in use since 1897<sup>29</sup> and is a mature industry with several major suppliers, for example:
  - 3.5.5.1 Statnett SF
  - 3.5.5.2 Global Marine Systems

3.5.5.3 Visser Smit Hanab nv

3.5.5.4 Van Oord nv

3.5.5.5 Waller Marine Inc.

3.5.6 We suggest the use of a barge is well suited for the shallower waters of the Bristol Channel.

#### Section 6 – connection of DC to AC

3.6.1 The Nation is supplied with Alternating Current, AC, and so any transmission cable using Direct Current, DC, has somewhere along the line to be converted to Alternating Current, AC . This happens where it is connected to part of the national power grid using Alternating Current, AC.

3.6.2 The converters are built up of many "valves". These valves although sounding as if they were something used in old radio and TV sets are solid state and are continuously being improved and reducing in price in the same manner as domestic products.

3.6.3 These valves are typically Voltage-Sourced Converters, VSC, using Insulated Gate Bipolar Transistors, IGBT, for fast switching.

3.6.4 The Converter stations for a 4000 MW, 4GW, station would be about 300m square or similar area.

3.6.5 Converting "Valves" have been available since 1904 and Voltage-Sourced Converters, VSC, since 1990's<sup>30</sup> in a mature industry with several major suppliers for example:

3.6.5.1 Siemens

3.6.5.2 ABB Power Technologies AB

3.6.6 These Voltage-Sourced Converters, VSC, can instantly change the direction of power.

#### Section 7 – The subsea route

3.7.1 The Consultation document<sup>23</sup> issued to residents showed no subsea alternative, and this omission has been corrected and added, and is shown as a suggested route in fig 6.

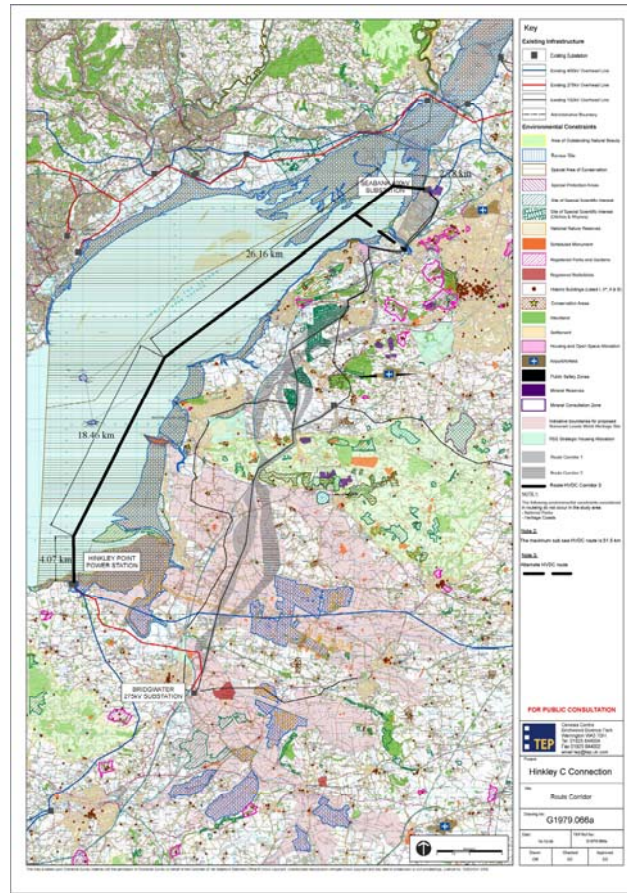


Fig 6

- 3.7.2 The National Grid's Strategic Optioneering Report<sup>31</sup>,SOR, received 10<sup>th</sup> December 09, stated, identified and dismissed this route as H6.
- 3.7.3 This route is at maximum 51.5 km so can be laid in one "drum" of cable from converter station near Hinkley to converter station near Seabank.
- 3.7.4 We suggest that the Seabank converter station is given an alternate route to bypass the waters across the entrance to Avonmouth Docks which are subject to shipping.
- 3.7.5 The subsea route does not cross any shipping lanes or any designated anchoring zones. It is common practice for ships to be prohibited from anchoring within 2 nautical miles of a subsea power or telecommunication line.
- 3.7.6 The subsea cables can interfere with the earth's magnetic field relied upon by sailors. However, as the location of these power lines are close to land sailors will be more likely to rely upon Global positioning, SATNAV, and Radar.
- 3.7.7 Interference with the earth's magnetic fields may disorientate some marine mammals such as seals and whales. These rarely visit this area<sup>32</sup> and the effect is localised and could be acquired by mammals to benefit navigation.

Section 8 – The cost of provision

- 3.8.1 The cost can be readily calculated, however as the key providers are very discrete in their commercial dealings and do not want to issue detailed costings for fear of prejudicing their sole client, in this case the National Grid. We have been only provided with guide figures.
- 3.8.2 The converter stations are currently costing £50,000 per MW and there needs to be one station each end of the cable to connect to the Alternating Current, AC, power grid. In this case therefore, we need 2x4000MW converted or 8000MW
- 3.8.3 The various cable manufacturers produce their own designs and "off the reel" designs at 400kV can carry up to about 2000Amps, A. A Mass Impregnated, MI, cable at top end price is £500/m. This will dramatically reduce with Cross Linked Polyethylene, XPLE to £250/m.
- 3.8.4 Cross Linked Polyethylene, XPLE, cable is currently undergoing trials at 400kV for High Voltage Direct Current, HVDC, but currently run at 200kV.
- 3.8.5 For Direct Current 2 cables are required one for the positive and one for the negative. It is possible to use the sea or ground as the negative but this would cause unacceptable heating to the environment.
- 3.8.6 The return cable can be dedicated negative with less insulation and substantially less expensive. This would remove flexibility for maintenance should it be required to run the positive pole through it any date in the future.
- 3.8.7 The cables can also be supplied with their own negative return in a single cable called Integrated Return Cable, IRC. This simplifies cable laying, removes magnetic interference and saves cost.
- 3.8.8 National Grid have specified 10,000 A so we suggest the more flexible and expensive 10 insulated cables in total, 5 positive and 5 negative. As the single length is 51.5 km the total length is 515km.
- 3.8.9 Multiple cables will allow for:
  - 3.8.9.1 "Up scaling" or increasing capacity by adding cables as demand changes.
  - 3.8.9.2 Ease of maintenance by taking one or more out of service, or even changing polarity of a cable, without significantly altering total transmission capability.
  - 3.8.9.3 The ability to stage upfront costs by not installing total capacity until required.
- 3.8.10 A cable laying barge hires out at £30,000 per day and can lay 26km per day. To lay 515km would take about 20 days.
- 3.8.11 A new cable laying barge with a drum able to hold 80km of 75mm cable to a top specification including a helipad is £20,625,000. This cost could be recouped by sale at end of project.

<b>4000 MW 400 kV 10,000 Amps</b>			
	Unit cost	Units	subtotal
Converter station	£50,000	8000	£400,000,000
Cable 2000 A	£500,000	515	£257,500,000
Cable laying	£30,000	19.8	£594,231
New barge	1	£20,625,000	£20,625,000
Sale of barge	1	£18,000,000	-£18,000,000
<b>GRAND TOTAL</b>			<b>£660,719,231</b>

3.8.12 We suggest a total price of £661 million for provision for a High Voltage Direct Current, HVDC, Subsea transmission system using a 10 Mass Impegrated, MI, cables. This design using existing mature technology could carry 4,000 MW, 4GW, at 400,000 volt, 400kV with an instant reversing current capability of a Voltage-Sourced Converters, VSC to connect to existing national power grid.

## Section 9 – Conclusions

3.9.1 We suggest a total price of £661 million for provision for a High Voltage Direct Current, HVDC, Subsea transmission system.

3.9.2 Current Voltage-Sourced Converters, VSC, can instantly change the direction of power.

3.9.3 Multiple cables will allow for:

3.9.3.1 "Up scaling" or increasing capacity by adding cables as demand changes.

3.9.3.2 Ease of maintenance by taking one or more out of service, or even changing polarity of a cable, without significantly altering total transmission capability.

3.9.3.3 To stage upfront costs by not installing total capacity until required.

## **APPENDIX 4**

### **GLOBAL WARMING**

#### **Section 1 - Overview**

- 4.1.1 "Global Warming" is the increase in the average temperature of the Earth's near-surface air and oceans since the mid-20th century and its projected continuation.
- 4.1.2 It is a prime National Policy<sup>33</sup>, and supported by many other Nations, that all possible means are used to reduce heat being lost to the atmosphere.
- 4.1.3 This heat lost to the atmosphere "warms the globe" directly and can have a financial cost to the Nation.
- 4.1.4 The detailed calculations are shown in Appendix 13 see Table 7.

#### **Section 2 – Heating effects of overhead power transmission**

- 4.2.1 National Grid has informed us that the cables will be running at 95°C and typically at 3900A at 400,000 volt, 400kV. This suggests about 39% of the capacity of a 4,000 MW, 4GW, 4GVA, design which runs at 10,000 Amperes, 10kA.
- 4.2.2 The proposal from National Grid was triggered by the new nuclear reactor at Hinkley. It is more efficient to run nuclear reactors at full load and so we suggest that heating losses are calculated when the power line is working at full load.
- 4.2.3 All generating plant is most efficient at full load however to balance demand to generated supply it is normal to switch on and off fast "start" and "stop" generators such as gas turbine, and hydro electric, generators.
- 4.2.4 The cable temperature is controlled by its size, wind speed, ambient temperature, heating effect of the sun and the power being transmitted. The larger the cable the lower the transmission losses.
- 4.2.5 The size proposed by National Grid has not been released but is usually determined by balancing off transmission losses against cost of providing larger cables insulators and pylons.
- 4.2.6 We have to make some assumptions from standard studies<sup>34</sup>. In these studies the heating effect will 120 W/m, at full load.
- 4.2.7 We understand heating in a domestic situation in terms of the unit, kWh - 1000 watts every hour, of electricity costing typically 10p. 1kWh of will provide enough electricity to supply for one hour "one bar" electric heater or the first level on a typical room fan heater.
- 4.2.8 National Grid has also informed us that they will use 18 cables in the overhead line for 60km.
- 4.2.9 Every meter of distance along the 60km path of the power line consumes 18 x 120w

- 4.2.10 Using the same analogy we can say that as a result every meter of power line is equivalent to two bar electric fires on day and night as long as the pylon is operational.
- 4.2.11 The energy directly inputted to warming the globe is 18cables x 60km x 120W/m x 1000m/km. This amounts to 129,600 MW.
- 4.2.12 This 129,600 MW is a loss of about 3% of the power being transmitted or said in another way adds 3.24% to our bills.

### Section 3 - Heating effects of subsea power transmission

- 4.3.1 A subsea High Voltage Direct Current, HVDC, line has less heating effect than a High Voltage Alternating Current, HVAC, line due to the nature of Direct Current having a lower peak voltage than Alternating Current.
- 4.3.2 Our suggested design for a 50 mm core subsea High Voltage Direct Current, HVDC, cable will only have 0.4% heating losses at full power.
- 4.3.3 In addition to the cable losses, the heating losses from the converter station must be considered.
- 4.3.4 The latest Voltage-Sourced Converters, VSC, run at 0.5% at full load.<sup>35</sup>
- 4.3.5 The total loss then will be Cable losses and two converter stations is 1.4%
- 4.3.6 The heating loss at the converter stations, although at a relatively low temperature, could be recovered by heat pumps.
- 4.3.7 Over 20 years at 10p/kW hr this would amount to a saving of £1287 million, at full load. If heat recovery from the converter stations was 80% efficient this would add another £561m of savings.

### Section 4 – Conclusions

- 4.4.1 We suggest that the proposed National Grid overhead power line:
- 4.4.1.1 Increases effects of Global Warming more than 2 times that of our High Voltage Direct Current, HVDC, subsea design.
- 4.4.1.2 Adds 129.6 MW to the effects of Global Warming.
- 4.4.2 If this rate of loss is typical on all overhead power lines this loss would add 3% to all Electricity Bills.

4.4.3 We suggest that over twenty years a High Voltage Direct Current, HVDC, subsea design could save about £1287 million over the proposed National Grid proposal.

4.4.4 We suggest that on this criterion of Global Warming alone that this proposal from National Grid fails when compared with a High Voltage Direct Current, HVDC, subsea design.

## APPENDIX 5

### HEALTH ISSUES

#### Section 1 - Overview

- 5.1.1 The proposed routes of Pylons and HV Transmission Lines have generated anxiety, stress and worry. Should they become a reality then these anxieties will manifest themselves in very real symptoms.
- 5.1.2 The tranquillity of the countryside will be lost. The benefits of the countryside in helping people recover from stress will be lost and there becomes no escape from the urban stress for city dwellers.
- 5.1.3 The perceived risk of cancer is very real to most people. The experts may argue about the detail but the evidence is perceived to be sufficiently strong for people not to want to take the risk.
- 5.1.4 The evidence shows that there is an association between living near power lines and various human diseases which is sufficiently strong for people not to want to take the risk.
- 5.1.5 The conclusion is inescapable that a failure of the National Grid to exercise reasonable skill and care in the discharge of their duties could eventually lead to claims for negligence.

#### Section 2 – Health Studies

- 5.2.1 Detailed analysis of a range of research studies reported in peer-reviewed scientific journals has been undertaken by molecular geneticist, Dr. A Merry (PhD, Bristol 2007).
- 5.2.2 We consider this paper so important that it is included in full Appendix 11
- 5.2.3 Dr. Merry discusses several recent papers that show there is an association between proximity to power lines and some human diseases, including some cancers and some neurodegenerative disorders.
- 5.2.4 The current research on animals and human cell cultures has not conclusively shown a direct cause and effect between power lines and human diseases. However, this is a very active research area and Dr Merry considers it is likely a causal link will be uncovered within a few years.
- 5.2.5 The National Grid proposes to place lines very close to a Wraxall Primary School. This could be forced to close if parents consider their children to be at risk.

#### Section 3 - Conclusions

- 5.3.1 There is a 100% certainty that exposure to sufficient radiation causes cancer.
- 5.3.2 Scientists have recognised a safe limit to the amount of exposure to a magnetic field humans should have as a result of their working or living conditions. It is possible that some people are exposed to above this, generally recognised limit, as a result of living near a power line.

- 5.3.3 It is also possible that other effects, currently being investigated by the Human Radiation Effects Group at Bristol University, contribute to the association between power lines and some human diseases.
- 5.3.4 The actual illnesses caused by radiation of an overhead power line may be increased by the long term internalised worry, stress or fear of living near an overhead power line.

## APPENDIX 6

### PROPERTY BLIGHT

#### Section 1 - Overview

- 6.1.1 The documents referenced are produced by The Royal Institution of Chartered Surveyors and Stake holder Advisory Group on Extremely Low Frequency, ELFs, and Electric Magnetic Fields, EMFs, SAGE. SAGE is a government advisory body set up to work in conjunction with National Grid to investigate the effects of high voltage power lines.
- 6.1.2 There are American studies which whilst not being entirely relevant to the legal system in the UK, they cite examples where people have experienced a negative impact on their property values.
- 6.1.3 Personal experience is that property near a power line has extended periods of viewing, discounted value and still unsold after several years. Despite devaluations being estimated by various bodies anecdotal devaluation rates are more commonly 30% to 50%.

#### Section 2 – Studies

- 6.2.1 In summary, the reports suggest a negative impact on property values by between 5 and 30% in Europe and The USA.
- 6.2.2 The Stake holder Advisory Group's, SAGE , reports<sup>66,67</sup> conclude that National Grid estimate an average of 15% reduction in value if a residential property is located less than 50 metres from a High Voltage Power Line, HVPL, in attractive rural areas. Wraxall and Failand would qualify for an attractive rural area.
  - 6.2.2.1 SAGE states: *"The impact of the power line on the value of a property very much depends on the type of property. For individual homes in a rural location within 50m of National Grid lines, an average diminution in value of up to 15% (compared to what the same property would be worth without the power line) has been experienced. Larger devaluations are quite possible where the visual setting is a large part of the attractiveness of the property. However, on large housing estates, where the visual setting is less important, the average devaluation per house for properties close to the overhead line is probably less than 5%."*
- 6.2.3 In respect of compensation, SAGE<sup>67</sup> sets out its interpretation of the law in respect of compensation as follows:
  - 6.2.3.1 SAGE states: *"Electricity companies do not usually own the land the lines pass over. Lines are present by a contractual arrangement between the landowner and the electricity company called a "wayleave" or an easement". If a landowner loses value because of the presence of a line over it, they can claim compensation from the electricity company, but owners of adjacent land have no rights to compensation. More detail on contractual and legal issues is in Supporting Paper S16."*
- 6.2.4 The Royal Institution of Chartered Surveyors, RICS , reports<sup>60,61</sup> outline guidance to it's valuers/chartered surveyors and comments that properties may be down-valued by 1-

15% (depending on distance from the line), prices achieved on the open market (between a willing buyer and willing seller) often do not reflect this level.

6.2.5 In addition, the RICS reports that in a survey undertaken on their behalf, proximity to power lines was not considered as high risk as other everyday risks experienced by members of the public, table 1.

	Public	Rank
smoking cigarettes	14.0	1
driving down a motorway in the rush hour	10.2	2
drinking alcohol	9.7	3
living near high voltage overhead power cables	9.1	4
living near a sewage works	8.4	5
using a garden pesticide	7.3	6
having an x-ray	6.8	7
taking paracetamol	5.4	8
using an intercity train	5.3	9
driving down a motorway when it is very quiet	5.2	10=
using a bus to get into town	5.2	10=

Table 1: Subjective rating of “everyday” risks (1 is lowest; 19 is highest)

6.2.6 The American report<sup>64</sup> cites real examples where private housing has been purchased and HVPL’s increased and up to 30% loss of value has been experienced.

### Section 3 – Values of homes near power lines

6.3.1 In addition to evidence on specific devaluation near lines, there is also some evidence that homes near lines may be less valuable than the average for the country as a whole. National Grid used the Hometrack postcode-level data on house values and took a random sample of homes within 50 m of National Grid lines in summer 2003. On that basis the average value was £115k per home, 85% of the then national average of £135k. The national average is now £224k (December 2009) so it is assumed the average value of property within 50 m of National Grid lines is now £190k. On this basis, the value of residential property in proximity to National Grid lines is shown in Figure 2.

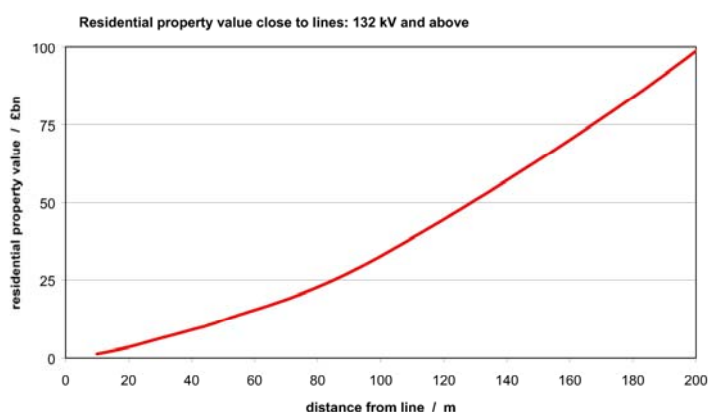


Figure 2

## Section 4 – Conclusions

4.6.1 The impact of new overhead transmission pylons can have on:

4.6.1.1 Agricultural land is to devalue by up to 15% from the sterilization of the corridor under the lines due to the requirements of the Health and Safety at Work Act, HASAW.

4.6.1.2 Land and property is to devalue by up to 15% even when only in the vicinity of transmission lines.

4.6.1.3 High value property when combined with location and view then this devaluation is higher and in some cases can become worthless and even unsaleable.

## **APPENDIX 7**

### **IMPACT ON TOURISM**

#### **Section 1 - Socio-economic assessment**

- 7.1.1 This arises from visual and landscape character assessment as its impact leads to a reduction in the well being of all who pass through the area but particularly those who are resident in the area and derive a living from the area.
- 7.1.2 No study appears to have been undertaken. We suggest that an informed decision can not be made without a detailed study.

#### **Section 2 – Tourism overview**

- 7.2.1 Tourism is a major contributor to the economy and employment of the area. It is also a transit route for visitors to the South West.
- 7.2.2 This generates up to 10 million overnight stops and 13 million day visits and some 10% of all employment, generating an economy worth £760m. (Extract, Tourism in Somerset – 5 yr plan 2006-2010).
- 7.2.3 We wish to identify for an example a business within the Parish of Wraxall and Failand that we believe could well be affected by the proposals; Noah's Ark Farm Zoo. We anticipate a significant drop in visitors, because of the visual impact of the extra pylons and transmission lines, together with visitor perception and concerns at being in such close proximity to the Pylons and Transmission lines as they pass, either through or very close to the site.
- 7.2.4 The National Grid proposals threaten this economy and employment by projecting a negative image of the area, which will be despoiled by 50 m Pylons and 400 KV transmission lines. These eyesores will be visually obtrusive, they will “hum” and set up Electromagnetic fields which may discourage visitors from stopping.
- 7.2.5 This key economic driver, and all the good work put in by the tourist boards and their partners, will be undermined. The very essence of the areas attractiveness, the preservation of the varied landscape, which is vital for the continued attraction of visitors, will be blighted.
- 7.2.6 Should these pylons and transmission lines be permitted, then the natural and cultural heritage of the area and its distinctiveness will be changed for ever.

#### **Section 3 - Policy**

- 7.3.1 The European Academies Science Advisory Council's<sup>36</sup>, EASAC, policy report 11 of May 2009 states on page 7 clause 3.5 Technical Planning of new lines:

“The choice should be made in such away that the technical properties, economics and environmental impacts are taken into account in each case. There cannot be any single technology best suited for all cases. When considering the economic aspects, a life cycle cost analysis is key”

#### Section 4 – Conclusions

- 7.4.1 There will be a contraction of the Local tourist Industry a replacement industry will be required.
- 7.4.2 Guidance from European Policy has not been followed.
- 7.4.3 Decisions are being taken which will damage local industries without study or costing.

## APPENDIX 8

### IMPACT ON VISUAL AMMENITY

#### Section 1 - Overview

- 8.1.1 The whole of the South West is an area of considerable beauty.
- 8.1.2 Many areas are designated as of outstanding natural beauty. But the beauty does not stop at the boundary lines. It blends in to a landscape of changing character and interest.
- 8.1.3 Dispersed throughout the area are pockets of buildings and dwellings, some in isolation, some in villages, some in larger settlements.

#### Section 2 - Study

- 8.2.1 National Grid has failed in its duty to inform its decision making process, by only carrying out a desk top study and not carrying out a Land Character Assessment.
- 8.2.2 We suggest therefore the decision on both the choices of overland approach is ill informed.

#### Section 3 - Character

- 8.3.1 The imposition of these highly intrusive, 46.5m, pylons to support eighteen cables every 365 m will harm the character of an area and impact on the openness of the countryside for generations to come.
- 8.3.2 Quote from section 38 of the Electricity Act 1989; Re preserving amenity states: "*We interpret amenity to mean the natural environment, cultural heritage, landscape and visual quality. We also include within this interpretation the impact of our works on communities, such as the effects of noise and disturbance from construction. This statement applies to all works on national Grid's electricity transmission system in England and Wales. By works we mean constructing new transmission infrastructure such as overhead lines, underground cables, sealing end compounds and substations; major refurbishment of any of these; and the dismantling of any parts of the system*".
- 8.3.3 Quote from the Landscape Character Assessment section of Landscape Character Network; part of Natural England; "*Landscape is more than the "view". It is the dynamic backdrop to our lives. It is how we perceive the relationship between nature and culture in our surroundings. It is shared cultural heritage, a living record of the interaction between people and place that is vital to our local and national identity .It is a driver for local economies, a resource that must be carefully managed and maintained. Decisions that change the landscape directly affect the quality of our lives. Landscapes can mean an everyday area as much as a beauty spot, and all landscapes*

*require tailored approaches that protect, manage and plan for their sustainable futures."*

- 8.3.4 Landscape character is defined as *"a distinct, recognizable and consistent pattern of elements in the landscape that make one landscape different from another, rather than better or worse"*. Put simply, landscape character is that which makes an area unique.
- 8.3.5 Only by paying proper regard to the existing character of our landscapes can informed and responsible decisions be made regarding their management, and sustainable future landscapes are planned.
- 8.3.6 Through understanding how places differ we can also ensure that future development is well situated, sensitive to its location, and contributes to environmental, social, and economic objectives.
- 8.3.7 The need to enhance landscape character is endorsed by the Government in Planning Policy Statements and is one of the central aims of Environmental Stewardship.
- 8.3.8 *"The HVDC transmission technology is developing rapidly and should be considered as an appropriate method of bulk transmission from point to point. These developments are significant in relation to public objection to new overhead lines owing to their visual impact"*. This is the view of the European Academies Science Advisory Council<sup>36</sup>, EASAC.

#### Section 4 – Conclusion

- 8.4.1 Local landscape will be damaged irreparably. There can be no replacement benefit until they are removed.
- 8.4.2 Guidance from European Policy has not been followed.
- 8.4.3 Decisions are being taken which will damage local amenity without study or costing.

## **APPENDIX 9**

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## **APPENDIX 10**

### **Hugh Pratt**

#### **Qualifications**

Hons.Degree Mech,Eng. University College London	1973
MSC. Degree Ocean Eng U.C.L	1974
Phd High Voltage Engineering of Insulating links. U.C.L	2002 -date

#### **Work History**

University Apprentice - Rolls Royce	1969
Ocean Industries Ltd. Managing Director	1972-2006
Load Monitor Ltd	1990-date
President InsulatUS inc.	1994-date
President Crane Power Line Safety	2004-date

#### **Appointments**

Member of BSI Pel 036 Insulators	2005-date
Member of IEC SC36B- UK Representative	2006- date

#### **Significant Awards**

18 International Patents, 7 patents on Insulating link

5 National Awards, including Millennium Award

#### **Significant Presentations**

Extended presentations to:

1. ANSI B30
2. National Safety Council
3. California Construction Association
4. Specialised Carriers and Riggers
5. ANSI C29
6. OSHA Cranes and Derrick Advisory Committee
7. Crane Safety 2003
8. IEC TC36
9. IEEE
10. CIGRE

# Chris Ambrose

## Profession

Chartered Building Services Engineer

## Nationality

British

Established Chris Ambrose Associates Limited in 2003.

## Qualifications

Chartered Engineer (CEng)

## Professional Associations

- \*Fellow Association of Consulting Engineers (FCons.E)
- Fellow Chartered Institution of Building Services Engineer (FCIBSE)
- \*Member Institute of Plant Engineers (MIPlantE)
- \*Fellow Royal Society of Health (FRSH)
- \*Member Chartered Institute of Arbitrators (MCI Arb)
- \*Fellow Faculty of Building (FFB)

## Committees

- 1980 – 1984 CIBSE Guide Committee Swimming Pools
- 1980 – 1985 CHP Committee, North West
- 1980 – 1984 RIBA Energy Group, North West
- 1988 – 1997 CIBSE (South West) CPD Committee Regional Membership Co-ordinator
- 1992 – Present I.O.D. (South West)
- 1995 – 1998 Faculty of Building Committee, Great Western Branch
- 1999 – 2002 Team/Reference Group – Rethinking Procurement of Health Building by the NHS

## Publications

- Thermal performance of elements, RIBA North West, October 1979.
- Underground District Heating Mains, International Consulting Engineer, July 1980
- Dehumidification heat recovery in swimming pools, IEE May 1981
- Condensation, The long and short term argument for heat pumps for buildings, March 1983.
- Bristol Energy Action Launch 1988
- Ozone disinfection in swimming pools, International Ozone Conference 1988

## Study Tours

- 1970 District Heating, Sweden
- 1978 Swimming Pools, Germany
- 1986 Shopping Centres, USA

\* lapsed @ 2009

## Key Data

### Director (Chris Ambrose Associates Limited)

2003 – to-date .Client advisor for Multi million \$ projects in Syria & Abu Dhabi.

2000 – 2003 Board Director of WSP at their Holborn office.

1975 – 2000 Director of Ove Arup & Partners and Ove Arup & Partners International, with responsibility for the Arup PFI Group and Arup Project Management. Prior to this he was the on-site Project Director for APM on Project New World for CSFB. Key issues were establishing the design team agreements and managing contractors' contracts and master programmes. Before this he led the design of the building services for St. Pancras International Railway terminal, part of

CTRL, key issues being Heritage requirements, extra large numbers of people and demanding operational conditions. He was also responsible for ensuring the closing out of rail safety issues and initiating an improved procurement method to ensure quality of product, consistency of use for maintainability and control of cost.

Prior to taking up this assignment on CTRL he was responsible for leadership and management of the 120 strong multidisciplinary Bristol office, where he had specific responsibility for building engineering in the South West and Wales. He was involved in the design and installation of a wide range of building services in a variety of buildings both in the UK and abroad. These include local authority, industrial and commercial projects for chemical production facilities with high efficiency air filtration systems and close tolerance humidity and temperature controls to shopping centres, corporate office buildings and the development of new swimming pools and leisure centres with low energy consumption and improved water filtration systems.

### **Litigation**

Chris acts as an Expert Witness in litigation and adjudication cases.

### **Selected PFI Projects**

1998 – 2000

- TA to the funder for MoD Whitehall (£550m)
- Glasgow Schools (£300m)
- Worcester Royal Infirmary (£80m)
- Kings College Hospital (£55m)
- Baglanmoor Hospital (£50m)
- GCHQ Cheltenham SPV (£300m)
- Worcester Royal Infirmary (£80m) as ICE to Trust

1998

- Project New World for CSFB – Refurbishment & New Build of 1.3m ft<sup>3</sup> (£500m)

1996 – 1998

- CTRL high speed railway – St. Pancras International Terminal, Ebbsfleet and Stratford stations and Swanscombe Control Centre.

### **Career History:**

1988 – 1996: Director, Ove Arup & Partners, Bristol. Liaising with developers & funding agencies for projects including £100m Galleries Shopping Centre and BA747 maintenance hangar. Office refurbishment & development projects including Bank of England in Leeds & Newcastle, Time & Life, Berkeley Square, London

1986 – 1988: Regional Director, Ove Arup & Partners, Bristol.

1985 – 1986: Regional Director, Ove Arup & Partners, Manchester.

1975 – 1985: Senior Engineer/  
Associate, Ove Arup & Partners, Manchester.

Projects included exhibition centres, hotel refurbishments, theme park study, office and sports complex, swimming pools, shopping centres, power station in Kuwait and combined heat and power report for the Regional District Heating Scheme of the Marshall Committee.

1960 – 1975: Various positions with contractors, local authority & manufacturing projects included Cardiff Head Post Office, Bradford PHQ. Pharmaceutical block, District Heating Schemes, St. James Hospital, Cattle Market, Central Bus Terminal. Civic Centre, high rise flats, comprehensive school, Police HQ, Crewe Training College, Turtle Wax factory, Mons Hotel.

# Amanda Sutherland

## RECENT EXPERIENCE AND SKILLS

### **Specialist Planning Consultant Jan 06 – date**

Since January 2006 I have increased my private consultancy work as a professional planning consultant. I provide advice to clients on development opportunities for their property portfolios and conducting planning appeals (including advocacy), advising on Enforcement issues and Certificates of Lawfulness as well as assisting clients in negotiations. I have advised in relation to Listed Buildings, agricultural development and ties and achieved permission for the first Carbon Neutral office development in Weston-super-Mare. My practice also works with Park Home Legal Services to provide a specialist planning service for caravan park owners and occupiers.

### **Planning Solicitor – Bristol City Council**

#### **Sep 04 –06**

I had responsibility for advising planning officers on current law and policy, advising members on their roles, drafting and negotiating s.106 agreements and supporting the Highways officers with respect to the Public Rights of Way network (stopping – up, diversions and s.38 agreements).

### **Law Lecturer – Weston College, Weston Super Mare**

#### **September 2003 – July 04**

I undertook the provision of legal teaching on the AS and A2 Law courses. This was extended, following my successful completion of the new FETC (level 4) Stage 1 certificate, to include providing lectures on the legal aspects of other courses. This included Business Law for those starting up a company and Housing and Planning Law to Housing, Planning and Environmental Health professionals on day release.

### **Executive Manager, Head Office Operations, The Environment Agency 12/12/2000 to 3/9/2003**

The role provided strategic support to the national Director of Operations by delivering effective provision of solutions to a reactive workload, to include corporate risk management, accountability for and management of the operation of two teams within Head Office Operations, budget management of approx 600K, corporate planning, major incident review, Internal and National Audit Office recommendation implementation.

### **Solicitor, Head Office legal team, The Environment Agency 11/09/1999 – 12/12/2000**

Key work areas included:

- advising project teams on the legal implications of their work and the legality of the documents/policies produced
- responsibility for the implementation and interpretation of the PCB Regulations 2000 and provision of advice to specialist officers/project team
- general responsibility for legal training nationally, to include organisation of appropriate courses as well as delivery of training for lawyers but also the provision of legal support and training delivery to national operational staff such as Environmental Protection Officers

### **Trainee / Solicitor, Burges Salmon 1997 – 1999**

My training contract included Company Commercial, Private Client (matrimonial and estate planning), Commercial Property and two seats in Property (returning to specialise in Planning and Environmental Law).

In this last seat, I was assisting in providing advice to major national clients including;

Ministry of Defence

advising and instructing counsel for Foster Yeoman Ltd in relation to their Dulcote Quarry appeal

preparing and successfully achieving permission for the extension of Cadbury Garden Centre making it the second largest in the country.

My role also included development of legal updates and training for clients and legal staff.

**QUALIFICATIONS**

Environment Agency Internal Management Courses :

Leadership, Business Risk Management, Job Evaluation, Interviewing Skills,  
Project Management, Budget Management, Facing the Media, Media skills, Making Meetings Work and  
Stress Management for Managers

formal:

2003 – 2004 City and Guilds Level 4 Certificate in Further Education Teaching  
1997 – Date Continuing Professional Development via Law Society including the Law Society Management Course Stage  
1 and regular Environmental Law updates  
1995 – 1997 PG Dip in Legal Practice **Merit**  
UWE, Bristol – part time over two years to fit around work and children  
1992 – 1995 LLB (Hons) **2:1**  
UWE, Bristol – full time – including: planning and environment, commercial, roman law, torts, ELS,  
European Law  
1990 – 1991 Pharmaceutical Industry Exams (PIA) **Pass**  
Open Learning via employer  
1998 Chartered Institute of Bankers exams  
Exeter University, Open Learning via employer  
1986 – 1988 A Levels: Sociology **A**  
Art **C**  
History **E**  
1986 O Levels: 10 including English and Maths  
Certificate of Community Service for assisting with disabled children on a voluntary basis (1986)  
DOB -3/11/69

# **Ben O'Connor**

**Associate, BA (Hons) BTP MSc MRICS**

Year of birth: 1972

## **Academic qualifications:**

BA (Hons) Town and Country Planning  
Bachelor of Town Planning (BTP)  
MSc Commercial Property Management

## **Professional qualifications:**

Member of the Royal Institution of Chartered Surveyors (Qualified 1999)

## **Summary of experience:**

### **August 2003 to date**

#### **GVA Grimley, Bristol**

Ben is an associate responsible for Offices Agency team in Bristol and The South West. Ben is currently retained by a variety of government departments and private companies to acquire office accommodation across the region. He is currently instructed on approximately 1,000,000 sq ft of disposals, 100,000 sq ft of acquisitions and land with potential for approximately 2.5 million sq ft of future development.

### **2002-2003**

#### **Judd Farris Professional Property Recruitment**

Working as a recruitment consultant, Ben established the planning and development recruitment team for the South West and built up strong client relationships with developers, house builders and professional consultants.

### **1998-2002**

#### **Carter Baines, Bristol**

Development agency including speculative and retained acquisitions and disposals on behalf of retail, roadside, development and house builder clients across the South West and South East. Advising clients on issues including availability of alternative sites, town planning and market advice.

### **1997-1998**

#### **King Sturge, Bath**

Graduate Trainee working assisting with development disposals, valuations and Landlord & Tenant instructions across Bath, Somerset and Wiltshire.

## **Project experience:**

**North & South Plaza, Bristol** – acting on behalf of Schreiber Holdings Ltd in the disposal of 160,000 sq ft of office accommodation in two buildings. North Plaza (55,000 sq ft) was let to Axa and sold to Kodak Pension Fund (early 2005). South Plaza (105,000 sq ft) has been 85% let to the Bristol PCT, CIP Solicitors (now Morgan Cole) and The Soil Association.

**Eden Office Park, Ham Green, Bristol** - acting on behalf of the developer, Rokeagle in the disposal of new build office accommodation over 7 phases of development. This park is now considered one of the most successful small unit business parks in Bristol.

**British Telecom Disposals, Bristol, Gloucester Swindon & Exeter** – acting on behalf of Telereal to dispose of surplus office stock in the region.

**Royal Bank of Scotland, South West Acquisitions** – Acting on The Bank’s behalf to identify and acquire offices in Bristol and the South West to facilitate their ongoing regional property re-organisation.

**Land Securities Trillium** – advice on site acquisition searches for The Department of Work and Pensions in South West and South Wales

**The Garden Room, Swindon** – Sale of 40,000 sq ft Call Centre with development land to Developer and 40,000 sqft of office lettings to local and national occupiers.

**Lydiard Fields, Swindon** – Disposal of business park with planning consent for 146,000 sq ft of which 104,000 sq ft has been built to date and 82,000 sq ft has now been let or sold.

**The Audit Commission** – National client management role coordinating agency, landlord and tenant and building surveying related instructions across all GVA offices as part of an OGC contract.

## Dr. Alyce Merry

### **Qualifications**

Biochemistry (Bristol University) 2001- 2003

PhD Molecular Genetics 2007

### **Work History**

Nailsea School as Maths teacher and as a member of the Senior Management Team

Bath Spa University in their School of Education as further Maths Support Programme.

Open University as an Associate Lecturer for a science degree course.

## **APPENDIX 11**

### **Living near Power Lines**

#### **Summary**

A child whose birthplace is within 200 m of an overhead power line is 69% more likely to get leukaemia than a child whose birthplace is over 600 m away (England and Wales, 2005).

An adult who lives at least 15 years within 50 m of an overhead power line before death is twice as likely to die of Alzheimer's disease, and over 40% more likely to die with senile dementia, than an adult who lives further than 600 m away (Switzerland, 2009).

This review attempts to explain the two studies that yielded these results, and other similar studies, the science behind the studies, and what is being investigated now by scientists who want to know why there is an association between proximity to power lines and some human diseases.

#### **Introduction**

This review is in three sections: epidemiological studies; studies on workers, animals and cell cultures; long-distance effects of power lines. The first section is a review of epidemiological studies starting with the 2005 paper published jointly by the Oxford Childhood Cancer Research Group and John Swanson of the National Grid. This paper is about childhood leukaemia (note the American spelling of leukaemia appears in several papers) in England and Wales and proximity to power lines. This was the research referred to by a member of the audience at the public meeting held in the Scotch Horn Centre in November 2009, and that led to the National Grid being accused of playing Russian roulette with children's lives. Then four more recent papers that also consider proximity to power lines are reviewed. These are about neurodegenerative diseases in Switzerland (2009), adult and childhood cancers in Tasmania (2007), childhood acute leukaemia in Malaysia (2008) and childhood acute leukaemia in China (2008).

Although there is evidence for an association between some diseases and proximity to power lines there is no consensus as to whether this is due to a causal link – i.e. whether the power lines are a risk factor for developing the diseases. One theory, supported by the fifth paper above, is that the proximity of power lines leads indirectly to DNA damage. The second section outlines the current state of knowledge about possible causality using examples of papers that report research on workers with occupational exposure, animals and cell cultures.

One of the issues that is controversial is how far away a human has to be from a given power line to be safe. The neurodegenerative study in Switzerland found no effects beyond 50 m but the England and Wales childhood leukaemia study found that even at over 200 m away there

is still a positive association with childhood leukaemia. In the third section hypotheses about longer-distance effects are discussed.

## Section 1: Epidemiological studies

### Childhood cancer in relation to distance from high voltage power lines in England and Wales: a case-control study

Published in BMJ (originally British Medical Journal but now always shortened to BMJ). BMJ. 2005 Jun 4;330(7503):1290.; Authors: Gerald Draper honorary senior research fellow<sup>1</sup>, Tim Vincent research officer<sup>1</sup>, Mary E Kroll statistician<sup>1</sup>, John Swanson scientific adviser<sup>2</sup>  
<sup>1</sup>Childhood Cancer Research Group, University of Oxford, Oxford OX2 6HJ; <sup>2</sup>National Grid Transco plc, London WC2N 5EH

#### Summary

This was a retrospective study of all sorts of childhood cancer. It looked at the distance from a power line for the birthplace of each patient and a matched control. A significant result was found for leukaemia; none was found for the other cancers.

The distance from the nearest power line of the birthplace of 9700 children who contracted leukaemia before they were 14 was recorded. The dates were between 1962 and 1995, and the birthplaces were in England or Wales. For each child in the sample a control child was selected, matched according to sex, date of birth (to within 6 months) and birth registration district. The distances for these children were also recorded and then the differences between the two distributions of distances (the one for the children who did get leukaemia and the one for the children who did not get leukaemia) were analysed.

If there is no association between proximity to power lines at birth and incidence of leukaemia the distributions should be the same apart from non-significant fluctuations. In fact the distributions were significantly different. For the children who did get leukaemia the distribution was skewed towards the shorter distances – i.e. the numbers were higher for all the ranges 0-49 m, 50 – 99 m, 100-199 m, 200- 299 m, 300 – 399 m, 400 – 499 m, 500 – 599 m, but the number for the last range 600 – 1000 m was lower than for the children who did not get leukaemia.

A mathematical analysis was used to calculate relative risks. The risk is relative to the risk of getting leukaemia if a child lived 600 – 1000 m away from a power line. The analysis allows you to say how confident you can be in the numbers. For example, the data means that the 95% confidence interval for the relative risk for children living 0 – 199 m from a power line is between 1.13 and 2.53, with best estimate 1.69. Technically this means that the interval 1.13 – 2.53 has a 95% chance of containing the true relative risk. No statistical test is 100% sure – the only way you can be 100% sure of a result is to record every single piece of data. For example if you wanted to estimate the number of fish in a pond you would net some live fish, tag them and put them back, then net some fish again and see how many in the new catch

were already tagged. This would give you (after some mathematical analysis) an estimate of the number of fish in the pond. The estimate would have a confidence interval attached to it – the more confidence you want the wider the interval. The only way to be 100% confident is to drain the pond and count the dead fish. In practice most experimental research aims at 95% confidence – though sometimes 99% confidence.

Returning to the paper: we can be 95% confident that the relative risk for a child who lives within 200 m of a power line at birth compared to a child who lives 600- 1000 m away from a power line at birth of getting leukaemia before age 14 is between 13% and 153%, and our best estimate is that the relative risk is about 70% more likely. Note an increased risk of 1.53 or 153% means the child is over two and half times more likely to contract leukaemia. The 95% confidence interval for a child living over 200 m away but less than 600 m away was 1.02 – 1.49 with best estimate 1.23 – i.e. 23% more likely to get leukaemia.

Liam Fox made the point in the public meeting that he chaired between the National Grid and Save Our Valley that it is hard to evaluate increased risk if you do not know the usual or base rate. The authors estimated:

*“The annual incidence of childhood leukaemia in England and Wales is about 42 per million; the excess relative risks at distances of 0-199 m and 200-599 m are about 0.69 and 0.23, respectively, giving excess rates of 28 and 10 per million.”*

And:

*“We estimate that of the 9.7 million children in the population (2003 estimate), at birth about 80 000 would have lived within 199 m of a line and 320 000 between 200 and 599 m. Thus, of the 400-420 cases of childhood leukaemia occurring annually, about five would be associated with high voltage power lines, though this estimate is imprecise.”*

There were several critical responses to this paper which were published in BMJ 2005 Sep 17;331. The only one worth mentioning here is that the study looked at 275 kV and 400 kV lines but most 132 kV lines were omitted.

The authors were surprised to find there was a significantly increased risk for children living over 60 m away, and even for children 200 – 599 m away compared to 600 – 1000 m away at birth. The reason for their surprise was that at distances over 60 m from the power lines the magnetic fields should be below what is an accepted critical damaging threshold.

Magnetic field strength is measured in Tesla (T), but the Tesla is too big a unit for most fields encountered. A critical value for a mean daily field in a UK home is taken to be 0.3 - 0.4  $\mu$ T (1,000,000  $\mu$ T = 1 T). The sources for this damaging threshold are discussed in these papers:

Ahlbom et al. A pooled analysis of magnetic fields and childhood leukaemia. Br J Cancer

2000;83:692-8.

Greenland et al. A pooled analysis of magnetic fields, wire codes and childhood leukaemia.

*Epidemiology* 2000;11:624-34.

This critical value was confirmed in a more recent paper: Kabuto *et al.* Childhood leukemia and magnetic fields in Japan: a case-control study of childhood leukaemia and residential power-frequency magnetic fields in Japan. *Int J Cancer*. 2006 Aug 1;119(3):643-50

The researchers found an odds ratio (this is like the relative risk) of 4.67 (95% confidence interval 1.15 – 19.0) for children developing acute lymphoblastic leukaemia (ALL) whose bedrooms had a mean magnetic field strength  $\geq 0.4 \mu\text{T}$  compared to children whose mean bedroom level was below  $0.1 \mu\text{T}$ .

The National Grid publishes data on typical and magnetic field strengths at varying distances from all types of overhead lines, always measured at 1 m above ground.

<http://www.emfs.info/Sources+of+EMFs/Overhead+power+lines/summaries/distance+for+field.htm>

Voltage	Distance (m) for typical field to fall to:				
	10 $\mu\text{T}$	1 $\mu\text{T}$	0.4 $\mu\text{T}$	0.1 $\mu\text{T}$	0.01 $\mu\text{T}$
400/275 kV	*	30-40	50-60	90-110	200+

\* typical fields from this line do not reach this value anywhere

Thus a distance of at least 60 m from a 400 kV overhead line is required to ensure the typical field has fallen below  $0.4 \mu\text{T}$ , and a distance of 30 m is required for a 132 kV overhead line.

The typical field is *not*, however, the same as the measured field for any particular line. For example: the National Grid states the typical field strength underneath a 132 kV line is under  $2 \mu\text{T}$  but maximum values are about  $30 \mu\text{T}$ :

<http://www.emfs.info/Sources+of+EMFs/Overhead+power+lines/specific/132+kV+overhead+magnetic.htm>

Actual measurements by Professor Henshaw’s Human Radiation Effects Group at Bristol University taken for six 132 kV lines in the Bristol area yielded an average of about  $6.5 \mu\text{T}$ :

<http://www.electric-fields.bris.ac.uk/magfields.html>

The National grid also gives some information about actual average fields, for example:

<http://www.emfs.info/Sources+of+EMFs/Overhead+power+lines/summaries/average+transmission+fields.htm>

The following table gives more detail on the average magnetic field at various distances from National Grid lines. These figures were calculated from one year's worth of recorded load data and are the average for a representative sample of 43 different lines (a mixture of 275 kV and 400 kV).

Distance m	0	5	10	20	30
Average Field $\mu\text{T}$	4.00	0.52	0.13	0.03	0.01

If the critical field strength of  $0.4 \mu\text{T}$  is not found at distances beyond about 60 m the results reported in this paper suggest there must be an alternative explanation for the significant relative risks found. One alternative hypothesis due to Professor Henshaw's Human Radiation Effects Group at Bristol University was inconclusively tested by the authors (they admit they used an oversimplified approach which basically assumed all winds are from the south west). This hypothesis is discussed in section 3, but note that the National Grid website says of this paper: <http://www.emfs.info/The+Science/Research/Draper>

*"There is no evidence the results are explained by the "corona ion" hypothesis".*

The phrase "corona ion hypothesis" refers to the hypothesis due to the Human Radiation Effects Group. The sentence in italics does *not* mean the authors disproved the corona ion hypothesis, just that their data did not allow them to prove or disprove the hypothesis.

## Residence Near Power Lines and Mortality From Neurodegenerative Diseases: Longitudinal Study of the Swiss Population

Published in AMERICAN JOURNAL OF EPIDEMIOLOGY Volume: 169 Issue: 2

Pages: 167-175 JAN 15 2009 ;Authors: Huss A1, Spoerri A1, Egger M1,2, Roosli M1 ;1. Univ Bern, Inst Social & Prevent Med, CH-3012 Bern, Switzerland ; 2. Univ Bristol, Dept Social Med, Bristol, Avon England

### Summary

This paper is about the diseases associated with old age rather than childhood, specifically neurodegenerative diseases, and proximity to power lines (220 - 320 kV). Mortality data from 2000- 2005 for the whole of Switzerland was used for the study and so the numbers involved were very large, for example they used data concerning 9,228 deaths from Alzheimer's disease and 28,288 deaths from senile dementia. Adults under 30 at the time of the 2000 census were excluded. They used census data to track individuals who had lived at the same address for at least 5, 10 and 15 years before death. The authors defined corridors of 0– 49 m, 50–199 m, 200– 599 m, and over 600 m for recording proximity and they determined the proximity at the time of the 2000 census. The authors deliberately extended the range to 600 m because they wanted to make their results comparable to those reported by Draper *et al* in the 2005 paper.

The authors adjusted their comparisons to take into account possible confounding factors including sex; educational level; highest reported occupational attainment; civil status (single, married, divorced, widowed); urbanization category (city, agglomeration, rural municipality); and language region (German, French, Italian). They also allowed for the number of apartments per building as they considered this to be a potential risk factor for exposure to indoor wiring, and because Alzheimer's disease might be associated with benzene exposure they factored into their data an adjustment for living within 50 m of a major road.

No increased risk due to the proximity of a power line was found for all-cause mortality, several cancers, alcoholic liver disease, multiple sclerosis, Parkinson's disease or amyotrophic lateral sclerosis. Significant associations *were* found for Alzheimer's disease and senile dementia.

The adjusted hazard ratio (this is like the relative risk in the Draper et al 2005 paper) for Alzheimer's disease was 2.00, with 95% confidence interval of 1.21 – 3.33, for people who had lived for 15 years or more within 50 m of a power line. So people who lived this close to a power line for at least 15 years prior to death were estimated to be twice as likely to have died from Alzheimer's than people who had lived more than 600 m away from a power line for 15 years, and the 95% confidence interval for the increased risk is from at least 21% to as large as 233% (i.e. over 3 times more likely). The corresponding figures for senile dementia were 1.41, with 95% confidence interval 1.00 – 1.98.

The authors say:

*“Assuming that the associations observed in this study are causal, what are the public health implications? Considering the relatively small number of cases of Alzheimer’s disease and senile dementia diagnosed in the 50-m corridor (Alzheimer’s disease: 20 of 9,164 (0.22%); senile dementia: 59 of 28,045 (0.21%)), it is clear that the public health impact appears limited. The true public health impact, however, is difficult to determine. Rates of Alzheimer’s disease were reported to be from 2- to 8-fold higher if diagnoses were based on clinical examination instead of death certificates.”*

## **Residential exposure to electric power transmission lines and risk of lymphoproliferative and myeloproliferative disorders: a case-control study**

Published in INTERNAL MEDICINE JOURNAL Volume: 37 Issue: 9 Pages: 614- 619

Published: SEP 2007 ;Authors: Lowenthal RM1, Tuck DM 1, Bray IC2; 1. Univ Tasmania, Sch Med, Hobart, Tas Australia; 2. Univ Bristol, Dept Social Med, Bristol, Avon England

### **Summary**

In this paper the authors looked at the residential histories of patients over their entire lifetimes before diagnosis. This study included cases of adult as well as childhood diagnoses (cases studied were aged 0 – 94 years). The cancers were either lymphoproliferative or myeloproliferative disorders (LPD and MPD). The MPD are cancers due to excess production of any of the cells from the bone marrow while the LPD are cancers due to excess production of lymphocytes (white blood cells). Controls were matched by age and sex, and possible confounding effects of socioeconomic status and occupational exposure were allowed for when the results were analysed. The study was done in Tasmania where the power lines are of 88, 110 or 220 kV. There were 768 matched pairs of case-controls.

The risk factor or odds ratio (like the relative risk and adjusted hazard ratios of the two previous papers) for being diagnosed with any of the conditions is 3.23 with 95% confidence interval 1.26 – 8.29, for people who lived within 300 m of a power line at any time during the age 0 – 15 years, compared to people who never lived within 300 m of a power line. This means the 95% confidence interval for the risk factor for people living within 300 m of a power line at any time between 0 – 15 years compared to those who never lived within 300 m of a power line is from 26% more likely to over 8 times as likely to develop one of the cancers studied, and the best estimate is over 3 times more likely.

If the cases were restricted to the LPD (which includes acute lymphoblastic leukaemia) this was increased to 6.18 with 95 % confidence interval 1.37 – 27.90.

The authors conclude:

*“Although recognising that this study has limitations, the results raise the possibility that prolonged residence close to high-voltage power lines, especially early in life, may increase the risk of development of LPD and MPD later.”*

## **A Case-Control Study on the Association Between Environmental Factors and the Occurrence of Acute Leukaemia Among Children in Klang Valley, Malaysia**

Published in ASIAN PACIFIC JOURNAL OF CANCER PREVENTION Volume: 9 Issue: 4

Pages: 649-652      Published: 2008; Authors: Rahman HIA1, Shah SA1, Alias H2, Ibrahim HM3; 1. UKM, Dept Community Hlth, Fac Med, Kuala Lumpur, Malaysia; 2. UKM, Fac Med, Dept Paediat, Kuala Lumpur, Malaysia; 3. Kuala Lumpur Gen Hosp, Paediat Inst, Kuala Lumpur, Malaysia

### **Summary**

This paper reports a very different sort of study as it involved interacting with the people involved rather than only consulting records held in database. Data was collected about 228 children under 15 with acute leukaemia using a structured questionnaire. The cases were mostly acute lymphoblastic leukaemia (ALL) with some acute myeloid leukaemia (AML). Controls were 228 children under 15 with an acute illness other than cancer treated in the same two hospitals.

Socioeconomic, demographic, reproductive, genetic, lifestyle, and environmental factors were investigated. Three adjusted odds ratios (like the relative risks, adjusted hazard ratios and odds ratios of the three previous papers) were found to be significant. Two of these were for paternal smoking and paternal social contact (it's interesting that there is an association between affluence and risk of childhood leukaemia in Great Britain as reported in Draper GJ, Stiller CA, O'Connor CM, Vincent TJ, Elliott P, McGale P, et al. *The geographical epidemiology of childhood leukaemia and non-Hodgkin lymphomas in Great Britain, 1966- 83*. London: Office for Population Census and Surveys, 1991– the more affluent the greater the risk).

The third one was distance of home from a power line (this was only recorded as less than or greater than 200 m). The adjusted odds ratio for this was 2.3, with 95% confidence interval 1.18 – 4.49.

The authors conclude their paper with;

*“Thus, it is recommended that an anti-smoking campaign be carried out to include the risk of acute leukaemia in children whose parents are smokers. It is also recommended that future residential areas should be developed at least 200 m away from power lines.”*

## **Case-only study of interactions between DNA repair genes (hMLH1, APEX1, MGMT, XRCC1 and XPD) and low-frequency electromagnetic fields in childhood acute leukaemia.**

Published in LEUKEMIA & LYMPHOMA Volume: 49 Issue: 12 Pages: 2344-2350

Published: 2008; Authors: Yang Y1, Jin XM2, Yan CH1, Tian Y1,3, Tang JY2, Shen XM1; 1.

Shanghai Jiao Tong Univ, Shanghai Xinhua Hosp, Shanghai Inst Pediat Res, Shanghai Key; Lab Childrens Environm Hlth, Sch Med, Shanghai 200092, Peoples R China; 2. Shanghai Jiao Tong Univ, Sch Med, Shanghai Childrens Med Ctr, Shanghai 200092, Peoples R China; 3. Shanghai Jiao Tong Univ, Sch Med, Dept Environm Hlth, Shanghai 200092, Peoples R China

### **Summary**

Like the last paper this is about actual patients, but there are no controls. Here there were 123 children with sporadic acute leukaemia; 99 had ALL and 24 had AML. The authors analysed their genotypes (each human being has their own version of the human genome – this is called their genotype) with reference to five known DNA repair genes. DNA damage occurs all the time in our cells, caused by a wide range of physical and chemical agents both within our cells and in the environment (e.g.; dividing cells can make errors in replicating the DNA; UV light and mutagenic pollutants in the air/food/water can damage DNA, cellular mitochondrial metabolism can lead to oxidative damage to DNA). This damage is normally repaired so that no deleterious consequences such as cancer follow. The repairs are carried out by special proteins and these are encoded in our genomes by their corresponding genes.

Some particular mutations are known to occur in these repair genes – leading to the repair protein not being able to do its job properly.

The authors report a significant interaction between a particular mutation in the XRCC1 gene and distances from power lines/electric transformers of less than 100m – an even more significant interaction is reported for distances less than 50 m. The authors say:

*“No significant interactions between the proximity of the electric transformers and power lines and other genotypes were observed. No significant interactions were observed between genotypes and the presence of television sets, refrigerators or microwave ovens in children’s rooms, pesticides use or the presence of chemical factories or telecommunication transmitter within 500 m of the houses.”*

The paper suggests a biological mechanism to explain the link between leukaemia and power lines/ electric transformers. Childhood leukaemia is usually due to more than one mutation in the child’s DNA. This makes it plausible that the association found by several researchers between leukaemia incidence and distance from power lines/electric transformers is causal: proximity to power lines/electric transformers leads to DNA damage. For children with an inherited defect in a DNA repair gene this damage remains unrepaired - leading to an increased risk of leukaemia.

## **Section 2: Studies on workers, animals and cell cultures**

The previous papers were epidemiological studies looking for an association between types of cancer or neurodegenerative disease and proximity to power lines. The paper that found an association between a mutated form of the XRRC1 gene and proximity to power lines/electric transformers supports the hypothesis that proximity to power lines is a risk factor for DNA damage.

Power lines produce extremely low frequency electromagnetic fields. The frequency is measured in Hertz (Hz) – it is 50 Hz in UK and Europe. These extremely low frequency electromagnetic fields are called ELF-EMFs. The energy depends on the frequency, and for these extremely low frequencies the EMFs do not have enough energy to damage DNA molecules within living human cells directly. You might think this would make it unlikely that they could be a cause of DNA damage.

In fact there are many known biological processes in our cells that could be distorted in the presence of ELF-EMFs, leading to excess DNA damage, or less effective repair, or both.

### **Occupational exposure studies**

To test this idea researchers looked for DNA damage in cells taken from workers exposed to occupational ELF-EMFs (due to working with overhead lines, power tools etc). Specifically they looked at exposure to magnetic fields, mainly because these are considered more likely to penetrate the human body than electric fields (they pass through buildings and most materials so the human body is not normally shielded). Papers published in the years leading up to 2001 were not conclusive due to too many confounding effects amongst the workers such as exposure to airborne pollution and smoking, and to unreliable ways of assessing the occupational ELF-EMF exposure. Researchers have improved how they assess the exposures, and how they allow for other factors. However, one recent paper:

“Occupational exposure to magnetic fields and the risk of brain tumors.” Coble JB, Dosemeci M, Stewart PA, Blair A, Bowman J, Fine HA, Shapiro WR, Selker RG, Loeffler JS, Black PM,

Linnet MS, Inskip PD. *Neuro Oncol.* 2009 Jun;11(3):242-9, reporting a case-control study that used several ways of measuring exposure (maximum exposure level, total years exposure over 0.3  $\mu$ T, cumulative and average lifetime exposures), did not find any evidence for a link between occupational exposure to ELF-EMFs and brain tumours in adults.

There is one study that has found a positive association between the occupational exposure of a pregnant woman to ELF-EMFs during pregnancy and the incidence of acute lymphoblastic leukaemia in the child.

## **Maternal occupational exposure to extremely low frequency magnetic fields during pregnancy and childhood leukemia.**

Published in *Epidemiology*. 2003 Jul;14(4):437-41. Authors: Infante-Rivard C1,2, Deadman JE1.  
;

1Joint Departments of Epidemiology, Biostatistics, and Occupational Health, Faculty of Medicine, McGill University, Montréal, Québec, Canada.; 2Research Centre, Centre Hospitalier Universitaire Mere-enfant, Hopital Saint-Justine, Montreal, Canada.

### **Summary**

The authors looked at various measures of how exposed the working mothers had been to ELF-EMFs before birth. There were 374 case mothers and 375 control mothers. One measure was whether or not the mother had been exposed to an average hourly exposure at work of  $\geq 0.4 \mu\text{T}$  during pregnancy. The two occupations with average hourly exposures of  $\geq 0.4 \mu\text{T}$  were sewing machine operators ( $0.68 \mu\text{T}$ ) and electronics workers ( $0.43 \mu\text{T}$ ). 27 case mothers reported these occupations compared to 11 control mothers. This gave an odds ratio of 2.5 (95% confidence interval 1.3 – 5.0) for the children of working mothers who were exposed to an average hourly exposure of  $\geq 0.4 \mu\text{T}$  developing acute lymphoblastic leukaemia, compared to those whose working mothers were not so exposed.

### **Animal Studies**

Other researchers have used animal subjects, often rats. They have looked for DNA damage, effects on the brain at a cellular level, and for effects on reproduction, hormone levels and behaviour. Again the results have not always been conclusive. They are also often based on higher magnetic field strengths than are likely near to a power line. More than one group reports therapeutic effects of ELF-EMFs, for example (using 1 mT): Vázquez-García M *et al.* Exposure to extremely low-frequency electromagnetic fields improves social recognition in male rats. *Physiol Behav*. 2004 Sep 30;82(4):685-90. I briefly discuss two recent papers; the second paper has the benefit of using field strengths of relevance to human proximity to power lines and reports a very interesting result concerning an antioxidant enzyme.

## **Changes in synaptic efficacy and seizure susceptibility in rat brain slices following extremely low-frequency electromagnetic field exposure**

Published in Bioelectromagnetics: 2009 Dec;30(8):631-40; Authors: Varró P<sup>1,2</sup>, Szemerszky R<sup>1</sup>, Bárdos G<sup>1</sup>, Világi I<sup>1</sup>.; <sup>1</sup>Department of Physiology and Neurobiology, Eötvös Loránd University, Budapest, Hungary; <sup>2</sup>Animal Breeding and Animal Hygiene Research group of the Hungarian Academy of Sciences and Kaposvar University, Hungary

### **Summary**

This paper reports the results of a study that investigated the effects of ELF-EMFs on the neuronal activity of rats' brains. The researchers used some rats exposed to 500  $\mu$ T for 15 h (between 18:00 and 09:00), and some rats similarly exposed to 500  $\mu$ T for four consecutive days. The rats were then killed and brain slices were immediately tested using a range of electrophysiological measurements. They also tested brain slices removed from unexposed rats and then exposed to ELF-EMFs (250 - 320  $\mu$ T, 50 Hz) for one hour before the measurements were taken. The significant results reported were: the slices treated for one hour after removal and the brain slices removed from the exposed rats each showed significant, though different, differences in basic synaptic activity compared to controls. The word synaptic refers to the synapses between neuronal cells in the brain – these are junctions across which electrical activity normally takes place in order for signals to pass from one cell to another.

## **Evaluation of hormonal change, biochemical parameters, and histopathological status of uterus in rats exposed to 50-Hz electromagnetic field.**

Published in Toxicol Ind Health. 2009 Apr;25(3):153-8; Authors: Aydin M1, Cevik A2, Kandemir FM3, Yuksel M1, Apaydin AM1.; Departments of Obstetric and Gyneacology<sup>1</sup>, Pathology<sup>2</sup>, Biochemistry<sup>3</sup>, Faculty of Veterinary Medicine, Firat University, Elazig, Turkey

### **Summary**

In this research 21 female rats were placed in an environment designed to reproduce the effect of living alongside an overhead power line. 7 rats were continuously exposed to an ELF-EMF (50 Hz) for 1 month, 7 for 2 months, and 7 for 3 months. The magnetic field was about 4.8  $\mu$ T, while for 7 control rats it was about 0.048  $\mu$ T. No significant differences due to the ELF-EMF exposure were found in levels of several hormones and other molecules in the blood samples taken, or on the weights of the uteri, but there was a significant difference in the activity of the enzyme catalase in the blood. Catalase is an antioxidant enzyme, so a reduction in its activity suggests a reduction in the rats' ability to protect against oxidative damage in their cells. Much DNA damage is due to oxidative damage so this may suggest a link between exposure to ELF-EMFs and DNA damage.

### **Cell culture studies**

In view of some controversy about occupational studies and animal studies some researchers began experiments in which human cell cultures were exposed to ELF-EMFs in the hope that the exposure conditions could be tightly controlled and the question of whether ELF-EMFs cause DNA damage could be settled. The literature of peer-reviewed papers contains examples of such experiments that did lead to DNA damage, but also examples of experiments by other groups that could not reproduce the reported effects, or used different conditions (for example different types of human cells) and did not find any damage. Having read many of these I report here on one research group that had part of their work independently validated by another group over 5 years after their experiments were published. The two papers involved follow, and then after them I discuss a third paper which uses a different, much more reliable and sensitive method for detecting DNA damage, and which I therefore find convincing. Only one of the papers uses relevant magnetic field strengths, though.

## **DNA fragmentation in human fibroblasts under extremely low frequency electromagnetic field exposure.**

Published in Mutation Research/Fundamental and Molecular Mechanisms of Mutagenesis. Mutat Res. 2010 Jan 05;683(1-2):74-83 (published online in advance); Authors: Focke F1, Schuermann D1, Kuster N2, Schär P1.; 1. Institute of Biochemistry and Genetics, Department of Biomedicine, University of Basel, Mattenstrasse 28, CH-4058 Basel, Switzerland; 2. IT'IS Foundation, Zeughausstrasse 43, CH-8004, Zurich, Switzerland

### **Summary**

The authors set out to replicate the experiments of another group that reported (in 2002 and 2003) that intermittent ELF-EMFs (50 Hz, field strength 1 mT, 5 minutes on/ten minutes off for 15 h) led to significantly increased DNA fragmentation in human cells compared to controls. The authors were able to confirm the original findings. They hypothesise that ELF-EMFs affect replicating cells more than non-replicating cells and suggest that the reason for the previous variability in results reported by different research groups was that the proportion of dividing cells in the cell cultures used was not kept constant. To be fair they also suggest that the effect on DNA seen may be due to perturbed replication and excess cell death rather than to direct DNA damage – but this does not affect the validation of the previous research.

**Intermittent extremely low frequency electromagnetic fields cause DNA damage in a dose-dependent way.**

Published in International Archives of Occupational and Environmental Health; Int Arch Occup Environ Health. 2003 Jul;76(6):431-6.; Authors: Ivancsits S, Diem E, Jahn O, Rüdiger HW. ; Address: Division of Occupational Medicine, University Hospital/AKH, Waehringer Guertel; 18-20, 1090 Vienna, Austria.

**Summary**

This paper provided the original experiment that was successfully replicated by Focke *et al* in the paper above to be published in print in 2010 but available online in advance. In addition the authors found a field strength-dependent significant increase in DNA fragmentation between ELF-EMF intermittently exposed cells and controls. The significant increase in DNA fragmentation was seen at field strengths of 35  $\mu$ T and above (as before this was at 50 Hz, 5 minutes on/10 minutes off for 15 h). Focke *et al* did not try to replicate this part of their experiments – neither has it been queried or criticised by subsequent papers that cite this 2003 paper. This would suggest the peer community review process has judged these results to be valid.

## **Microsatellite analysis for determination of the mutagenicity of extremely low-frequency electromagnetic fields and ionising radiation in vitro.**

Published in Mutation Research/Genetic Toxicology and Environmental Mutagenesis. Mutat Res. 2007 Jan 10;626(1-2):34-41.; Authors: Mairs RJab, Hughes Ka, Fitzsimmons Sa, Prise KMc, Livingstone Aad, Wilson Lad, Baig Na, Clark AMa, Timpson Aa, Patel Gc, Folkard Mc, Angerson WJe, Boyd Ma.; Targeted Therapy Group, Division of Cancer Science and Molecular Pathology, Glasgow University, Cancer Research UK Beatson Laboratories, G61 1BD, UK;

<sup>b</sup>Department of Child Health, Yorkhill Hospital, Glasgow, UK; <sup>c</sup>Gray Cancer Institute, Mount Vernon Hospital, P.O. Box 100, Northwood, HA6 2JR, UK; <sup>d</sup>Department of Clinical Physics, Western Infirmary, Glasgow, G11 6NT, UK; <sup>e</sup>Department of Surgery, University of Glasgow, Royal Infirmary, Glasgow, G31 2ER, UK

### **Summary**

In this paper the authors did not look for indirect evidence of DNA damage shown by abnormalities at the chromosome level or evidence of breaks in DNA. Instead they looked at a finer level of detail; namely the number of mutations of DNA at 13 of the specifically defined places on the human genome called microsatellite sequences. This is a much more direct and sensitive way of detecting DNA damage than other methods. They report a 3.75-fold increase in the number of mutations in cells exposed to *continuous* ELF-EMF (50 Hz, field strength 1 mT for 12 h) compared to controls.

## Discussion

These last three papers provide strong evidence to support the hypothesis that ELF-EMFs (50 Hz, 1 mT field strength) result in significant DNA damage in some human cell cultures. But, as explained above, ELF-EMFs produced by power lines have field strengths much weaker than 1 mT (1000  $\mu$ T = 1 mT). However, the group that had some of its findings validated by Focke *et al* also investigated lower field strengths as discussed above. In particular they found effects for intermittent fields of 35  $\mu$ T; such strengths can be found within 25 m of a 400 kV overhead line as reported by the National Grid :

<http://www.emfs.info/Sources+of+EMFs/Overhead+power+lines/specific/400+kV+overhead+magnetic.htm>

Evidence that ELF-EMFs may damage DNA and certainly affect some cell cultures is interesting. I note they have also been shown to increase cell proliferation and to promote wound healing. See for example:

Delle Monarche *et al*. Extremely low frequency electromagnetic fields (ELF-EMFs) induce in vitro angiogenesis process in human endothelial cells. *Bioelectromagnetics*. 2008; Dec;29(8):640-8.

However it may be that a more useful level on which to focus on with regard to human health and proximity to power lines is the level of the whole human body. This brings me back to the hypotheses of Professor Henshaw's Human Radiation Effects Group at Bristol University referred to earlier.

### **Section 3: Long distance effects of power lines**

Evidence that it may not just be the ELF-EMFs that are potentially carcinogenic was first found by Draper et al in their 2005 paper as they found effects beyond the distance at which the magnetic fields are thought to have attenuated sufficiently to be completely harmless.

Two hypotheses for an explanation of this longer distance effect are those provided by Professor Henshaw's Human Radiation Effects Group at Bristol University. One hypothesis concerns mutagenic pollution and the other concerns disruption of the atmospheric electric field; both are facilitated by the power lines' effect on molecules in the air.

Molecules in the air are ionised by the high voltage of the power lines leading to free electrons, and positively charged nitrogen and oxygen ions, for example. Within nanoseconds these charged ions attract clusters of molecules, mainly water molecules. This charged cluster is called a small ion, or a corona ion. On a timescale of 10 – 100 seconds these small ions are attracted and attach to particles of air pollution. These charged pollutant clusters can be carried away in a plume, far from the line, hundreds of metres away. If inhaled these charged pollutants are more likely to stay in the lungs than uncharged pollutants, and are therefore more likely to pass into the blood and be carried to all parts of the body. If the pollutant molecules are also mutagenic DNA damage will then be more likely to occur. Thus the vicinity of a power line, and up to hundreds of metres away, could provide a mutagenic atmosphere to humans, compared to other areas.

## **Can disturbances in the atmospheric electric field created by powerline corona ions disrupt melatonin production in the pineal gland?**

Published in The Journal of Pineal Research. J Pineal Res. 2008 Nov;45(4):341-50. Authors: Henshaw DL, Ward JP, Matthews JC.; Address: H H Wills Physics Laboratory, University of Bristol, Tyndall Avenue, Bristol, UK.

### **Summary**

A second hypothesis discussed in this paper is based on the disturbing effect of the small ions on the electric fields in the atmosphere. This disturbance can take place up to hundreds of metres away from the lines. Human beings are adapted to a diurnal variation in the atmospheric electric field. Evidence is presented to support the hypothesis that exposure to fluctuating electric fields perturbs normal melatonin production in humans. Melatonin is, amongst other things, an antioxidant. As for catalase, any disruption of production would therefore impair DNA protection as much DNA damage is due to oxidative damage.

Written by A Merry, December 2009.

## APPENDIX 12

1) Letter to Dr Liam Fox available from:

<http://www.liamfoxmp.co.uk/type2show.asp?ref=33&ID=6>

**nationalgrid**

1100 Century Way  
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16 December 2009

Dear D Fox,

**Hinkley Point 'C' Connection**

Thank you for your letter dated 3 December 2009. I hope the local community found the public meeting on 27 November a useful addition to our consultation programme. We fully understand the strength of feeling of the community and I hope the answers we provided were helpful.

I attach a copy of our detailed optioneering report which was made available on our website on 7 December. This report sets out details of all the connections options considered, and the methodology by which we arrived at the proposed system reinforcements necessary to connect Hinkley Point C, including any potential for subsea cables as an alternative to new on-shore power lines.

The report concluded that the option which provided on balance the most appropriate solution would be to construct a new 400kV overhead power line between Bridgwater and Seabank substation in Avonmouth, and our current public consultation exercise is seeking feedback from local communities on two possible route corridors for this line. This consultation will close on 08 January 2010, after which we will consider all feedback and comments received. We will then determine a preferred route corridor and carry out a further public consultation on a proposed route alignment within that corridor to ensure local people have every opportunity to give us their views. Of course, we will be happy to answer questions about the optioneering process and the project as a whole throughout this period.

In your letter you refer specifically to the Long Island Neptune Project and I hope the following comments are helpful.

The transmission network in the UK, in common with most other nations, uses high voltage alternating current (AC) power lines as the means of transporting electricity. Overhead lines are used where possible, with underground cables being used more frequently in built-up areas. Underground cables cost around 12 to 17 times as much as overhead lines, and therefore we reserve consideration for their use to built-up areas where it is not possible to achieve an overhead route, and areas designated for their very high amenity value such as National Parks.

National Grid is a trading name for:  
National Grid Electricity Transmission plc  
Registered Office: 1-3 Strand, London WC2N 5EH  
Registered in England and Wales, No 2366577

National Grid is a trading name for:  
National Grid Gas Plc  
Registered Office: 1-3 Strand, London WC2N 5EH  
Registered in England and Wales, No 2006000

High Voltage Direct Current (HVDC) technology is also used around the world in special circumstances; typically where very long connections are required (hundreds of kilometres) and to provide interconnections between different AC transmission systems, such as our own interconnector with France.

HVDC systems use direct current, either through overhead lines or underground and subsea cables, to transfer power. Converter stations are required at either end to interface with existing AC networks. Converter stations are extremely expensive and as a consequence HVDC, using overhead lines as the transmission medium, only becomes economic over very long distances. Where the transmission medium is underground or subsea, HVDC systems can be economic at much shorter distances but only when compared against an equivalent AC underground or subsea connection, not compared with an AC overhead line.

The Neptune Project connects Long Island with the mainland, has a capacity of around 660MW and cost in the region of \$650m. The urban nature of the New York/Long Island area would have prevented an on-shore overhead connection and justified the high cost of a subsea HVDC connection. The Neptune cable allows Long Island Power Authority to purchase electricity from outside the area.

An HVDC connection in the Severn Estuary would need to be rated at around 4000MW and we estimate would cost in excess of £1bn more than an AC overhead line connection. Any HVDC connection in the Severn Estuary would in addition have its own environmental, technical and engineering difficulties and would require multiple cable connections.

As I explained at the meeting, the cost of either a subsea or underground cable on this connection would result in only a very small increase in charges to consumers. This connection is however just one part of the very major capital programme of works National Grid has across its networks, and this in turn is part of an even larger investment across the UK's energy networks as a whole. This investment is vital to the UK achieving its targets to move towards achieving a low carbon economy, and includes the connection of new renewable and new nuclear electricity generating capacity.

National Grid's approach of using overhead lines to provide transmission connections has been accepted by the Secretary of State in granting consent for a number of overhead lines over the last 15 years, including the Seabank Power Station connection to the north of Bristol. More recently on 2 December 2009 the Secretary of State granted consent for a new 21km 400kV overhead line in County Durham.

National Grid works closely with manufacturers and other utilities on the development and application of new technology. Superconducting cable technology may in time develop to present a practical and economic solution but currently, to our knowledge, there is no practical installation of any significant scale commercially operational.

I hope this reply is helpful. I would emphasise that we are committed to effective consultation with communities who may be affected by our proposals, and it is important that they have the opportunity to understand the issues which influence and constrain the decisions that we are required to reach. We continue to welcome local people's comments and views and will consider them carefully at each stage in the planning and development of this project.

Yours sincerely  
David Mercer

David Mercer  
Construction Manager, Major Works

2) Letter to Chris Ambrose – email addresses removed.

From: "David Hunt"  
To: "CHRIS AMBROSE"  
Cc: "Colin Green"  
Sent: Friday, November 27, 2009 3:30 PM  
Subject: RE: Hinckley C connection and transmission to Avonmouth

Chris,

I fear the reason given by National Grid is not accurate. It is National Grid's duty to plan and develop its system to meet the demands of its users in an economic, efficient and coordinated manner. Typically this has meant that National Grid has planned its system to be comprised mostly of overhead line (OHL), given that it is much cheaper to deliver comparable capacity using OHL than underground or sub-sea routes. As the regulator, we do not tell National Grid or any other transmission owner what to build - it is not within our power nor our desire to do so.

National Grid is required to take account of the impacts on the behaviour of its operations in accordance with schedule 9 of the Electricity Act, and I would assume that in developing its plans to use OHL in this circumstance, it has done so accordingly. If we assume that is the case, then there is a crucial role to be played by the planning process. If for example, planning consents will not be granted for a particular project unless it is underground/sub-sea, and this option was on balance the most efficient, we would typically allow the funding. It is therefore entirely inappropriate for National Grid to argue that it is our regulations that rule it out, and it is National Grid's job to take responsibility for the investment plans it puts forward.

Regards,

David

David Hunt  
Senior Manager - Electricity Transmission Policy  
Transmission  
9 Millbank  
London  
SW1P 3GE  
[www.ofgem.gov.uk](http://www.ofgem.gov.uk)

-----Original Message-----

From: Colin Green

Sent: 26 November 2009 19:08

To: CHRIS AMBROSE

Cc: David Hunt

Subject: RE: Hinckley C connection and transmission to Avonmouth

Hi Chris

I have forwarded your enquiry to my colleague (david hunt) who is a senior manager within Ofgem's electricity transmission policy team. As your enquiry relates to the connection of an onshore generating station then it falls within the area covered by my colleagues.

Regards

Colin Green

Head of Offshore Transmission Policy

Ofgem E-Serve

02079017143

Sent from a handheld device.

-----Original Message-----

From: CHRIS AMBROSE

Sent: 26 November 2009 18:19

To: Colin Green

Subject: Hinckley C connection and transmission to Avonmouth

Hi Colin,

I email as the Chairman of a local Parish Council.

At a recent exhibition held by National Grid, OFGEM regulations were stated to be the reason that Undersea transmission would not be considered for the above.

Can you confirm what OFGEM's position is in regard to National Power's decision making?

Many Thanks

Chris Ambrose CEng

3) "The Business Interview" – Sarah Arnott for The Independent can be found on:

<http://www.independent.co.uk/news/business/analysis-and-features/steve-holliday-the-undersea-secret-thats-bringing-more-power-to-the-people-1757503.html>

### **Steve Holliday: The undersea secret that's bringing more power to the people**

The Business Interview: The main item on the agenda for National Grid is to rebuild Britain's inefficient and antiquated electricity network, says Sarah Arnott

"I am boring," shrugs Steve Holliday, the chief executive of National Grid. "Let's stick to talking about the company." To the uninitiated, National Grid might also seem boring. Thanks to its nationalised past, the company is synonymous with Britain's electricity network, and it has perhaps the most risk-averse approaches to investment of any of its peers. But since it was privatised in 1995, National Grid has reinvented itself several times over, and behind the commitment to absolute investment certainty is a keen perception of the opportunities ahead. "It is such an exciting time in this industry," Mr Holliday says. "There is a revolution happening and we sit at the heart of it."

He is talking about climate change, of course. But first, the history. Post-privatisation, National Grid was quick to expand. In the UK, it went into gas, merging with Lattice Group – the infrastructure business of the former British Gas – to run four of the eight regional gas distribution networks. Since Mr Holliday took the top job three years ago, the sprawling group sold out of its South American businesses and doubled the size of its US division with the \$7.3bn (£4.4bn) purchase of Keyspan, leaving its £15.6bn revenues almost exactly split between Britain and the US.

The company has one of the safest business models imaginable. A massive 95 per cent of its revenues already come from regulated businesses, so its income is "decoupled" from the volumes its infrastructure carries. And the regulated business is about to get even bigger, as regulatory changes in the US follow the UK's de-coupled example. "Over the next 15 months, our exposure to volume goes from very small to none," Mr Holliday says. "Even for a utility – which is by definition seen as a lower risk business – we are exceptionally low risk."

Given such discipline, it is a great relief that Moody's finally concluded its review of the company this week and raised its outlook back to "stable". In early 2008 after the Keyspan takeover, the ratings agency downgraded its outlook to "negative" amid concerns about the group's £23bn debt pile, which is one of the largest in the FTSE 100. Mr Holliday is almost indignant. "This is the right level of gearing for this business," he says. The group has successfully issued £1.3bn in long-term debt since January, leaving only another £600m needed this year.

But even stable does not mean boring. For many in the once-grubby electricity industry, climate change is an opportunity for reinvention as a dynamic facilitator of society's greener future. And decoupling means National Grid can look at much more interesting business opportunities – such as energy efficiency services. "We want to invest hugely in energy efficiency but we won't do that if it's eating into our bottom line," Mr Holliday says. "There is potential for a huge energy efficiency business in the US. Last year we invested more than \$200m, and that is likely to double or triple in the next three to four years."

Not that new opportunities mean taking greater risks with investors' money. An existing example of the group's diversification into unregulated sectors is the Isle of Grain liquefied natural gas (LNG) terminal. It is an enormous programme, with two phases completed since 2005 and the third to be ready by next year. But each stage only went ahead once the capacity was sold far into the future. "We still lock in cashflow for 20 years before making the investment," Mr Holliday says. "We only invest when we get an allowed return."

In the UK, the main item on National Grid's agenda is to refresh the electricity infrastructure itself. The grid's architecture – designed around a central spine connected to a relatively small number of very large sources of power – is simply not appropriate for the 21st-century energy mix, with lots of smallish wind farms, both off and onshore, as well as the new nuclear power stations. According to the Energy Networks Strategy Group, Britain's power grid needs £4.7bn of unavoidable investment, 75 per cent of which will come from National Grid. But rather than simply boosting the existing network, the group has a more radical scheme to build new links running down each coast under the sea. The plan for the west coast – from Scotland to just south of Liverpool – is the most advanced. **It is no more costly than the more conservative upgrade plan.** And although there are some challenges – such as shifting the current to DC when it goes offshore, and AC when it comes back on again – none of the technical novelties is a showstopper. "I just don't think anyone ever thought of doing this before," Mr Holliday says. The plan for the eastern half of the plan has yet to be proven. **But the western undersea grid is a "no-brainer", Mr Holliday insists, even for a company as risk-averse as National Grid. Ofgem seems to agree. The regulator has made a rare exception to the rules and given National Grid the go-ahead to start work on the project before the business case is fully worked out.**

The company was allowed to collect an extra £10m through this year's transmission charge so that it can get on with the design work, and there are 120 engineers busy on the designs. "This is a pivotal moment for the industry because we are not just thinking about the usual five-year, regulatory time horizon," Mr Holliday says. "This needs to be in place by 2016, so we need to get on with it now and, while we are working out how it can be paid for, we have some revenues to maintain the programme." But there will be no further investment until there is a payback. "It is clear under every scenario that no one would regret this investment," Mr Holliday adds. "But we have not quite finalised how we will earn revenues, and until then we won't invest."

Despite an absolute priority on immediate investment returns, National Grid has ambitious growth plans. The company's UK division, which is still the biggest tranche of its investments, has capital spending running at more than £3bn a year, but that is nothing compared with the prospects for the future. "There are investment opportunities linked to nuclear and renewables, there is the offshore grid, pipes for carbon capture and storage and then the US investment also has to get going," Mr Holliday says. Whatever else it is, National Grid is certainly not boring.

On the right lines: Holliday's CV

- \* Steve Holliday has a BSc in mining engineering from Nottingham University.
- \* He has been the chief executive of National Grid since January 2007. According to Forbes, his salary this year is £929,000, with a £1.27m bonus.
- \* From 2002 to 2007, Mr Holliday was National Grid's group director for UK gas distribution and business services.
- \* From 2001 to 2002, he was its group director for UK and Europe.
- \* Before he joined National Grid, Mr Holliday was the executive director of British Borneo Oil and Gas.
- \* Prior to Borneo Oil and Gas, he spent 19 years with the US energy giant Exxon. During that time, he held senior positions in the company's international gas business, as well as managing its major operational areas including refining and shipping.
- \* Mr Holliday is also a non-executive director of Marks and Spencer.
- \* His interests include the England rugby team and the arts

## APPENDIX 13

### Over view

The following calculations are supplied so that our calculations can easily be followed and improved.

Overhead AC Power line		Heat loss	Total Heat Loss	Total Transmitted Power	Heat Loss
Distance	Number of wires				
km		w/m	kW	kW	%
60	x18	x120	=129600	/4000000	=3.24%

table 1

Undersea DC Power line		Heat loss	Total Heat Loss	Total Transmitted Power	Heat Loss
Distance	Number of wires				
km		w/m	kW	kW	%
51.5	10	17.4	16129.8	4000000	0.40%

table 2

DC/AC Converters		Average Loss		Total Transmitted Power	Total Heat Loss
	Number of Converters	%		kW	%
	2	0.50%		4000000	1.0%

table 3

DC/AC Comparison		DC Saving		Total Transmitted Power	Total Heat Savings
Total AC Losses	Total DC Losses	%		kW	kW
3.24%	1.40%	1.84%		4,000,000	73,470

table 4

Cost Savings		DC Saving per year	DC Saving 10 years	DC Saving 20 years	DC Saving 30 years
DC Savings	DC Savings per year	10p/kWhr	£ million	£ million	£ million
kW	kW hr				
73,470	643,598,952	£64,359,895	£644	£1,287	£1,931

table 5

Cost Savings			Average Domestic consumption	Average Domestic Bill per year	Total DC Saving
DC Savings			kWh	10p/kWhr	
kW					
73,470			3,300	£330	£6.06

table 6

Cost Savings		1% Saving per year at 10p/kWhr	1% Saving 10 years	1% Saving 20 years	1% Saving 30 years
Total Power in GB 2007	Total Power in GB 2007	£ billion	£ billion	£ billion	£ billion
GW hr	kW hr				
304,625	304,625,000,000,000	£305	£3,046	£6,093	£9,139

table 7

## APPENDIX 14

### WRAXALL & FAILAND PARISH COUNCIL

**Terms of Reference** for the setting up of a Group to respond to the National Grid's proposed 400KV transmission lines by the production of a report.

Authority; The PC at the mtg. on Tuesday 8<sup>th</sup> December 09 agreed to the setting up of a working group, under the direction of the chairman of the PC, Chris Ambrose. He was to invite appropriately qualified people to contribute to and produce the report on behalf of the PC and to present it to the PC for its adoption.

It was noted that the report submission date was 8<sup>th</sup> January 2010.

The following is likely to be required;

- To review all correspondence and information available.
- To acquire further and better information that may be available and appropriate.
- To liaise with others as necessary.
- To recognize the short time scale for consultations and the limitations this will impose etc.
- To issue a "best at time" draft report to the PC in sufficient time for consideration and general approval in order to meet the submission date.
- To recognize the ongoing nature of this proposal.
- To recognize the nature of the PC to reflect the views of all Residents.
- To make available for other PC's or groups to submit further and better information with editing and control by the original authors.
- To recognize that amended versions will need to be available for further submissions.

Material understood to be available;

Letter to residents and letter to Clerk together with a CD.

December 09 - CA