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THE EAGLES SYSTEM: AUTOMATIC RISK-BASED ASSESSMENT OF ASSET LOCATION ENQUIRIES

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ABSTRACT

Third party damage to buried and above ground apparatus continues to be a significant source of disruption and danger to workers and members of the public, and a source of financial and reputational loss to utility companies and contractors.

It is proposed that clear communication between the undertakers of work and asset owners is a key element in the prevention of third party damage to apparatus, allowing third parties to proceed with current, comprehensive and relevant information, and providing asset owners with advanced notice of proposed activities. Having advanced knowledge of potential threats in this way can be critical as a trigger for taking targeted action, such as site supervision or offering focussed guidance relevant to third parties and their activities.

Most pipeline operators have preventative measures in place as required for compliance with safety regulations. As well as considerations of physical protection, asset surveillance etc. these measures traditionally include the dissemination of asset location maps to third parties in the form of bulk data provision or on demand via, for instance, an internet mapping application.

This generalised data dissemination model has the benefit of simplicity and convenience on the part of the asset owner, and provides ready access to asset location records which may help to promote safe working. However, this model has a number of critical drawbacks:

- The distribution and maintenance of data distributed in bulk may be difficult to control, leading to out of date data being used by third parties to assess the impact of proposed activities.
- There may be no incentive for the third party to contact the asset operator for which they hold asset location records, meaning an assessment of the risk of specific activities may not be carried out by the asset owner or operator.
- The responsibility for making a judgement on the potential impact of proposed activities on apparatus may therefore be effectively passed to the third party, who may not be qualified to make such a judgement based on asset location records only.

Generally, the dissemination of asset location data may contribute to the prevention of third party damage, but can have a negative impact in that it does not encourage, and may actively discourage, communication between third parties planning to undertake works, and the owners or operators of apparatus which may be adversely affected by these works.

It is proposed that a more effective approach to the prevention of third party damage is the request-response model, whereby a third party contacts the asset owner with details of a specific planned activity, and the asset owner responds with information relevant to that request. This model allows the asset owner to make an informed judgement about the potential impact of specific third party activities on their assets, and provides third parties with up to date, comprehensive and relevant information.

However, this model can be extremely difficult to implement effectively, as it can be highly labour intensive and time consuming to deal with a large number of enquiries on a case by case basis, and may lead to delays in providing responses. Furthermore, it is impractical for staff with the relevant engineering experience to scrutinise every third party enquiry. The front-line filtering of enquiries may lead to administrative staff making engineering judgements about the potential impact of works for which they are not qualified. An ineffective implementation of the request-response model can therefore in itself act as a disincentive for third parties to contact asset owners, and may have a negative impact on asset protection.

This paper describes a web-based software system developed by GL Noble Denton in collaboration with National Grid in the UK that allows the preferred request-response model to be implemented in an efficient and effective manner. The system provides automatic risk-based assessments of third party activities as specified by the third parties, and is intended to promote a “virtuous circle” of communication between the undertakers of work and the owner/operators of apparatus, thereby reducing the risk of third party damage due to incomplete or out-of-date information and lack of communication.

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1 INTRODUCTION

Third party damage to buried and above ground apparatus continues to be a significant source of disruption and danger to workers and members of the public, and a source of financial and reputational loss to utility companies and contractors.

Most pipeline operators have preventative measures in place as required for compliance with safety regulations. The preventative measures deployed typically include elements of physical protection (e.g. slabbing), increased wall thickness, physical indication of the presence of buried assets (e.g. marker posts and tape), asset surveillance, the dissemination of asset location records and onsite supervision of third party activities.

This paper considers the advantages of effective exchange of information between the undertakers of work and the asset operators as a damage prevention mechanism, and describes a web-based software system that facilitates this effective exchange of information.

2 PROVISION OF ASSET LOCATION RECORDS

In the UK, asset location records have historically been distributed to third parties who engage in activities likely to cause a threat or impact to those assets, or who are involved in the formal planning processes for those activities.

This distribution of data has typically been in bulk form, with data (and often associated viewing software) being distributed periodically to licensed third parties in its entirety, or on a regional basis. More recently, asset location data has been made available via the internet, either for download in a commonly usable format, or via a web application which allows registered users to search for a location, and browse the asset location mapping of the operator providing the service.

The purpose of this “hands-off” distribution model has been to support early planning work and, where relevant, emergency works by other asset owners, where immediate access to asset records is critical. The bulk distribution of asset location data effectively serves this primary requirement of immediate and unfettered access, notwithstanding the problems of the bulk distribution model outlined below.

For scheduled activities which may adversely impact apparatus, the onus is on the undertaker of works (or those responsible for commissioning those works), to contact the operators of potentially affected apparatus with details of the specific planned activities. This contact enables the asset operator to provide specific guidance about the proposed works and, in the case of potentially high risk activities, to intervene more directly, for instance in the case of onsite supervision.

However, given the huge difference between the estimates which put the number of street works taking place in the UK at up to four million per year[1] [2], and the tens of thousands of enquiries received per year by a typical gas pipeline operator, it can be clearly inferred that very many excavations are taking place *at best* with reference only to asset location records received via a generalised distribution mechanism, and without direct consultation with the asset operators whose apparatus may be adversely affected by those excavations.

So providing asset location records to third parties via bulk data drops can be a relatively straightforward way to make records widely available. However, the distribution of media in this way can be costly; records are out of date as soon as they are distributed and widespread distribution of records in this way is difficult to control and can introduce risks to asset security from deliberate damage.

Finally, and most critically, a key incentive for the third party to inform the pipeline owner/operator about planned works has been removed, increasing the chance of high-risk works being carried out in close proximity to apparatus without the operator’s knowledge.

In general, if the undertaker of works is relying solely on asset location records provided via a generalised bulk distribution mechanism, the responsibility for making an assessment as to the potential impact of works on apparatus is effectively passed to the undertaker of those works, who may not possess the experience, qualifications or indeed the incentive to make that assessment.

The provision of interactive mapping data via the internet has the potential to solve problems of data currency, but this approach does not inherently increase the visibility to the operator of high risk works in proximity to their apparatus. This approach may also have implications in terms of security, with strict controls required over access to the system given the potential ability to browse asset locations at will.

The limited data available relating to the level and quality of information available to third parties who have been involved in pipeline damage incidents suggests that, in many cases, the operator did not have direct prior knowledge of the specific activities leading to the incident[3], and that the third party was aware of the presence of the pipeline[3]. Other incident investigations[4] have indicated that problems arose from an over-reliance on asset location records alone.

This data suggests that, as well as the application of safe excavation practices, a key element of damage prevention is direct communication between the undertaker of works and the owner of potentially affected assets, giving advance warning of potentially high risk activities to the asset operator, and the opportunity to provide focussed guidance and onsite supervision of works.

The lack of communication with the asset owner and the asset owner's lack of knowledge about high risk works is a potential pitfall of any system or process whereby third parties are given direct access to asset location data, and therefore given the implied responsibility for making a judgement as to which assets may be "affected" by their activities.

The benefits of a "virtuous circle" of communication between the planners and undertakers of work and asset operators are illustrated in Figure 1.

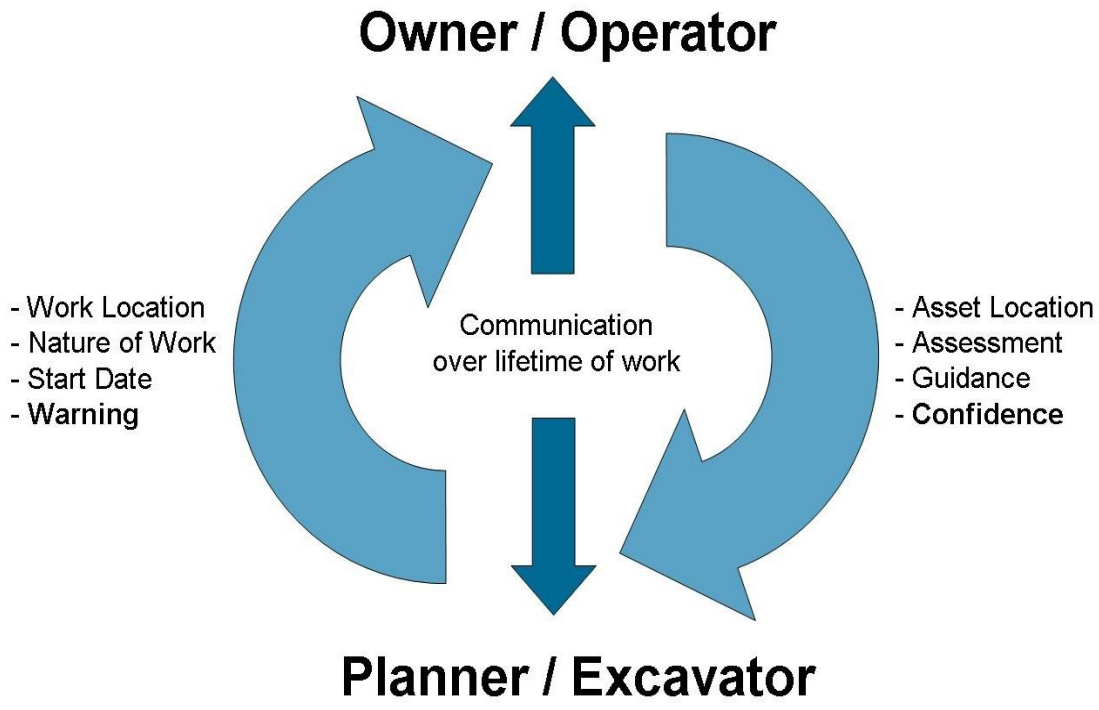

Figure 1 – A "Virtuous Circle" of communication between undertakers of work and owner/operators

3 REQUEST-RESPONSE MODEL

It is clear from the preceding section that direct communication regarding specific activities between planners and undertakers of work and asset owners is the preferred approach, and allows targeted action to be taken relevant to the proposed activities. Target action may simply comprise the provision of specific guidance relevant to the type of work being undertaken, but may extend to onsite supervision.

This "Request-Response" model is clearly a preferable approach in terms of effective, relevant communication and reduction of risk, but the manual application of this model can be extremely labour-intensive and time-consuming. If timely responses to requests cannot be consistently provided, undertakers of work will be less inclined to provide notification of works in the future, as their ability to meet deadlines may be compromised. Worse still, high volumes of enquiries may mean that the relatively small percentage of proposed works that genuinely do pose a high risk to apparatus may be overlooked amongst large volumes of lower risk works.

Clearly, if large volumes of enquiries are being received, it is not feasible for every enquiry to be scrutinised by a person with the relevant experience and qualifications to make an informed engineering judgement as to the potential risk of the proposed activity. To deal with large volumes of enquiries in a manual or semi-automatic way, some level of up front filtering by clerical staff is necessary to manage the input required from more highly qualified "back-office" engineering staff who should ideally focus on the relatively small percentage of enquiries that describe genuinely high risk activities. This filtering in itself presents a potential risk, in that clerical staff may be effectively making engineering judgements in their up-front deliberations, for which they are not qualified.

Online services operate in the UK that can reduce the volume of enquiries requiring scrutiny by asset operators by filtering out activities based on very simple proximity rules which dictate whether a given operator may be "affected" by proposed activities, and providing to the third party enquirer a list of potentially affected operators, with which the third party must subsequently make contact independently. In other parts of the world, the use of such systems and services (often called "One Call" systems) may be recommended or enforced by regulatory bodies. Studies indicate that, in areas where use of such a service is enforced by regulation, a high proportion of third party damage incidents are as a result of a failure to use that service on the part of the undertaker of works[5].

The risk of manual or even semi-automatic enquiry management processes being "swamped" and rendered ineffective is not insignificant, at least in the UK. The estimated number of actual street works undertaken in the UK has already been referenced as being up to four million[1] [2], and the growth in traffic through online "One Call" systems such as Linesearch which is being observed year on year[6] indicates that an increasing number of these activities are being received by asset operators as enquiries requiring a response. The national "Asset Portal" system for the UK being proposed by the National Underground Assets Group (NUAG)[7] will only lead to a growth in the number of enquiries being received by asset operators. This is clearly a significant and positive step forward in terms of facilitating communication, but effective systems must be put in place to deal with this increase in enquiries, such that it doesn't have the counter-productive effect of making asset operators less responsive to third parties.

These "One Call" services can lead to reductions in enquiries requiring scrutiny for sparse transmission networks, but are much less effective in filtering out enquiries for dense distribution networks, where any works will almost always be "close" to apparatus, and therefore flagged as potentially "affecting" the operator. In this case, finer-grained damage prevention rules are required in order to provide a "proceed with caution" level of response, and relevant asset location plans, without the requirement for expert scrutiny.

It is proposed that an automated method of quickly and consistently applying these fine-grained damage prevention rules to third party enquiries, such that those activities which, by transparent and objective assessment, do not pose a risk to the operator's assets can be responded to without expert intervention, leaving those activities which may be judged as "high risk" to be scrutinised and followed up by employees with the requisite expertise.

Such a method would offer a level of automated, risk-based filtering that would provide at a minimum:

- a timely response
- asset location maps and appropriate guidance such that low/moderate risk works can proceed safely without further intervention
- a clear notification of high risk works, allowing an expert manual risk assessment to take place, with a request to the third party to refrain from starting work until appropriate supervision or further guidance can be provided by the owner/operator

4 AUTOMATIC RISK-BASED ASSESSMENT OF THIRD PARTY ACTIVITIES

GL Noble Denton, in collaboration with National Grid, has developed a web-based software system called EAGLES, which allows details of proposed activities to be specified. These details are processed via an expert system which applies detailed damage prevention rules and other business rules in order to generate an email response appropriate to the level of risk which the proposed activities potentially pose to National Grid's assets.

4.1 Specification of Activities

The key elements of proposed activities that are captured by the system are as follows:

- **WHAT** the work will consist of. This includes details of excavation techniques and machinery used, auxiliary activities such as temporary storage of materials, heavy plant movements, changes to ground level etc.
- **WHERE** the work will take place. The precise location of the work is specified using interactive map mark-up on background geography and aerial imagery (no asset information is included in the mapping at this juncture).
- **WHEN** the work will take place. If work has a date of commencement, this is captured to help in the planning and resourcing of any supervision activities on the part of the asset operator.
- **WHO** will carry out the work. The status of the party undertaking the work, ranging from an experienced contractor to a member of the public extending their house, may influence the stringency of the damage prevention rules to apply to the enquiry.

All the required information is specified via a web-based interface, using constrained, validated input in the cases where the information will be subject to automated assessment. More discursive information which will support any follow-up activities can be entered as free text.

Details of proposed activities may be entered in "self-service" mode by the third party themselves, or by clerical staff in the asset operator's organisation, entering enquiries that have been received by traditional means.

4.2 Expert System Assessment

The information captured via the website is submitted to a backend database, and subjected to automated assessment by the innovative expert system which forms the core of the system. The primary focus of the damage prevention rules is the proximity of the proposed activities to the operator asset. The point at which a proposed activity is adjudged to constitute a threat to the asset based on its proximity to that asset is subject to the identification of the applicable permutations of activity details and asset attributes, the calculation of the risk of each permutation, and the aggregation of the results of those calculations.

The asset attributes which may dictate the proximity at which a given activity poses a risk to asset include:

- Pressure regime (or voltage level)
- Material
- Pipe diameter
- Depth of asset
- Age of asset
- Critical supply status
- Consequence of failure factor
- Etc…

Factors such as the status of the undertaker of the works may also feed into the expert system assessment of what constitutes a potential risk.

For the purposes of transparency and audit, the details of all the damage prevention rules which have been applied during the assessment are stored alongside the original enquiry and its response.

4.3 Automated Response

Once the expert system assessment has been applied, the third party enquirer receives an email response containing further instructions, guidance relevant to the activities specified and high quality, scaled asset location maps covering the area affected by the proposed works. Critically, this response is generated within minutes of the enquiry being submitted to the expert system, contrasted with a turnaround time of several days when a written enquiry is submitted for manual assessment.

Elements of the response may also be dictated by the **WHEN** and **WHO** elements of the enquiry (e.g. a start date in the immediate future may trigger a clause about reasonable notice; members of the public may receive more detailed guidance about safe working than employees of utility companies or engineering contractors).

Most importantly, the expert system assigns an overall risk level to the enquiry. For those enquiries flagged as Low or Moderate Risk, the response and asset location maps are considered sufficient information for the enquirer to conduct their work safely without further intervention from National Grid.

For those enquiries flagged as High Risk, the enquirer is asked to refrain from commencing work until a follow-up contact has been received from National Grid. The process for manual risk assessment and engineering judgement is then initiated, supported by the EAGLES system.

4.4 Enquiry Management

The “filtering out” of third party activities that do not pose a risk to operator assets is a key feature of the system in allowing the management of large volumes of third party enquiries.

Equally important is the identification of proposed activities which may pose a risk to operator assets. The response to these enquiries requests that the undertaker of works does not commence those works until further contact has been initiated by the asset operator. The enquiry is then flagged up for follow-up by the operator.

The system allows the status of these enquiries to be updated and monitored throughout the follow-up process which takes place independently of the EAGLES system itself. Once a resolution has been reached allowing the works to proceed safely, a final response containing the latest asset location maps and guidance can be generated to close the enquiry off.

5 SUMMARY

The expert system approach to the risk assessment of third party activities as implemented by the EAGLES software system described in this paper, allows objective, transparent, repeatable criteria to be applied to the assessment of third party enquiries.

Low/Moderate risk activities are responded to quickly and comprehensively, allowing works to proceed with the relevant information being available to the undertakers of works, and with no manual intervention on the part of the operator.

High Risk activities are identified quickly and are flagged up for further assessment, where expert engineering judgement can be applied. The follow-up process that takes place independently of the EAGLES system can be described and monitored in the system for audit purposes.

At the time of writing, the EAGLES system has been used by National Grid in the UK to process over 87,000 third party enquiries, with 41% of those enquiries being adjudged to cause no risk (or a low risk) to the assets under consideration. The average response time of the system in generating a response from a submitted enquiry is less than 30 seconds.

The automated risk assessment of enquiries allows all enquiries to be responded to in an appropriate and timely manner, and ensures that those works that pose a potential risk to apparatus are consistently identified and flagged up for expert assessment, according to criteria that are fully transparent and understood and consistent with the operator's risk management procedures.

By providing a timely and relevant response to enquirers, the system perpetuates a "virtuous circle" of communication between undertakers of works and asset operators, thereby reducing the risk of accidental third party damage and improving safety.

As a means of reducing third party damage by promoting effective communication between undertakers of work and asset operators, and by allowing the efficient management of large numbers of third party enquiries, it is suggested that the system developed embodies principles that may be of use and interest across the gas industry and to operators of other transmission and distribution networks.

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7 LIST OF FIGURES