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# HSE Management in Geothermal Drilling Operations
# Elementary Steps for Positive Progress in an International Environment

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**ABSTRACT**

Iceland drilling has over 70 years' history. In the early years the main client requirements were to deliver high quality wells for lowest cost possible. Health, safety and Environmental matters were regarded as the contractors' internal affairs and mishaps within these fields were quite common. With increased public and government social awareness in Iceland and around the world a stronger regulatory focus has been put on health, safety and environmental requirements across all industries. With increasing commitment of financial institutions and client engagement a sustainable progress has been made in this field in the past years, resulting in considerable lower accident and incident rate, which is not only beneficial for the parties involved but for the society as a whole. The main contributors to this success is that the client provides clear expectations and requirements in bidding documents and the contractor develops a Site Specific HSE management plan based on contractor QHSE management system to meet the requirements. It is equally important that the contractor and the client practice an open and honest communication in order to prevent incidents and continuously improve the operations. In this paper the IDC approach to achieve this is discussed. Examples from recent project in the Saint Vincent and Grenadines (SVG) will be used for demonstration.

## 1. INTRODUCTION

Drilling operations in an international environment around the world can be very challenging. The contractor is not only faced with different law requirements, but also cultural differences and different natural environment. To acquire reliable information on how to handle and manage all the aspects that arise during a project in the bidding period is a formidable and challenging task without thorough risk assessment and due diligence based on a site visit included in the bidding period.

The obvious point here is that, the clearer the bidding documents state the requirements the more likely it is that the requirements are met. Clauses like: Disposal of waste shall be according to local, state and federal regulations, are not very helpful and chances are that issues will arise during the project because of non-conformance. A more successful and responsible way is to identify the waste streams, specify the sorting and reporting requirements according to local laws and service availability and specify in the bidding documents. This approach of course applies to the HSE and other requirements as a whole for a specific project.

The contractor, has also to be equipped with the right resources and tools in order to be able to meet the contract requirements. The most essential is: Procedures analyzing the bidding documents and prepare a risk assessment on the bidding stage. Contract negotiation procedures to resolve all ambiguities and finalize a risk assessment. Site Specific HSE Plan, HSE procedures including a work permit system, clear Standard Operating Procedures, and employee training program.

Clear and good communication procedures must then be defined and followed during the project execution. An open and honest approach to challenges were the client and contractor cooperate when it comes to, analyzing issues, investigate incidents and grievances is most likely to deliver successful sustainable corrective actions.

## 2. PREPERATION OF HSE IN THE BIDDING DOCUMENTS

A key incentive for project developers to prepare tender documents that include clear and specific Environmental, Social, Health and Safety requirements is that financial institutions present these requirements as part of the funding program for the project. The World Bank has instituted International Finance Corporate Performance Standards for environmental and social sustainability. These standards provide important guidelines and are essential first step to successful HSE management in a geothermal project.

Another important step is that the project developer, the future client, and the potential contractor base their management programs on similar requirements, to speak the same language. A common approach to this is that companies adopt best practice standards that define these requirements, typically the ISO 9001, 14001, and 45001 series for Quality, Environmental and Occupational Health and Safety Management, respectively. Many companies are also adopting the ISO 26000 standard for Social Responsibility. Preparing the tender documents on basis of these standards will increase the probability that many requirement clauses the Performance standards and responsible HSE management will be met during the project implementation.

For the project in SVG the Project developer, Saint Vincent Geothermal Company Limited, (SVGCL) developed an Environmental and Social Management System (ESMS) based on the IFC PSs and ISO 14001 and 45001. Preparing an ESMS following standards forms the basis of the systems but to complete it is essential to involve stakeholders and research local conditions. For the SVG project this was done, local specialist were hired to research the endemic fauna and flora. Farmers and other businesses were interviewed, and compensations negotiated on the terms of the IFC guidelines on displacement and livelihood restoration. Finally the results of this work was incorporated into the ESMS which in turn was included in the tender documents.

### 3. HSE IN PROJECT PREPERATION AND EXECUTION

The first step after completing the negotiations is to define the responsibility of the project team. A task list is prepared, saved on a shared drive and followed up by the COO.

Next step is to take the bidding documents, the clients Project Environmental and Social Management System, requirement list and cross-reference them with the SSP HSE plan. Then the SSP HSE plan is issued as draft for the client review. Also project highlights are summarized in a PowerPoint presentation and made available for the project worker using Facebook as a communication platform. This ensures that all workers can familiarize themselves with the project specific requirements. The presentation is usually focused on cultural differences and vulnerability of the local ecosystem.

The first steps in execution of the project are to ensure safe transport of the rig to the new project location. This is prepared by completing a Journey Management Plan. This plan is sent for a review by the client HSE Manager who approves the Journey Management Plan. In a recent project in (SVG), a detailed and joint client-contractor road survey on the route from the Kingstone town harbor to the drilling pad near Georgetown on the east coast of the Island took place. During mobilization phase, local police authorities were involved to provide escort of convoys. The challenges are pedestrians as well as overhead power and communication lines as well as narrow roads. Historic tunnel with limited width and height, and mixed traffic of vehicles and pedestrians on the main highway.

The plan itself consisted of a map showing the route, pictures of all site on the way posing risk to the transport, and a risk assessment. Repair work of the road was also carried out were risks could not be mitigated in another way. The key step to successfully implement the plan was to have a meeting with all the stakeholders along the route including communities presenting the plan and answering questions. For this particular project the result was very acceptable, all major incidents were prevented.

Emergency preparedness is a key element of a successful HSE management. As early in the bidding stage this factor must be incorporated in the Risk Assessment. Referring to the same project in Saint Vincent, a mutual understanding of the emergency services available locally, and potential service needs of the contractor were ensured with a meeting with the local medical authorities prior the commencement of the drilling. On this meeting it was agreed to have a joint emergency drill to assess the reaction times and fine-tune response actions in an actual emergency case.

The HSE management during the actual drilling program relies on an active safety control structure. To understand the structure it is helpful to review the process of drilling a production well. As mentioned in the previous section the preparation of the drilling pad is normally the client's responsibility with a formal handover process which includes a joint inspection resulting in a punch list if something has to be improved. So the preparation of a drilling pad is not included as part of the process. The figure below shows the drilling process.

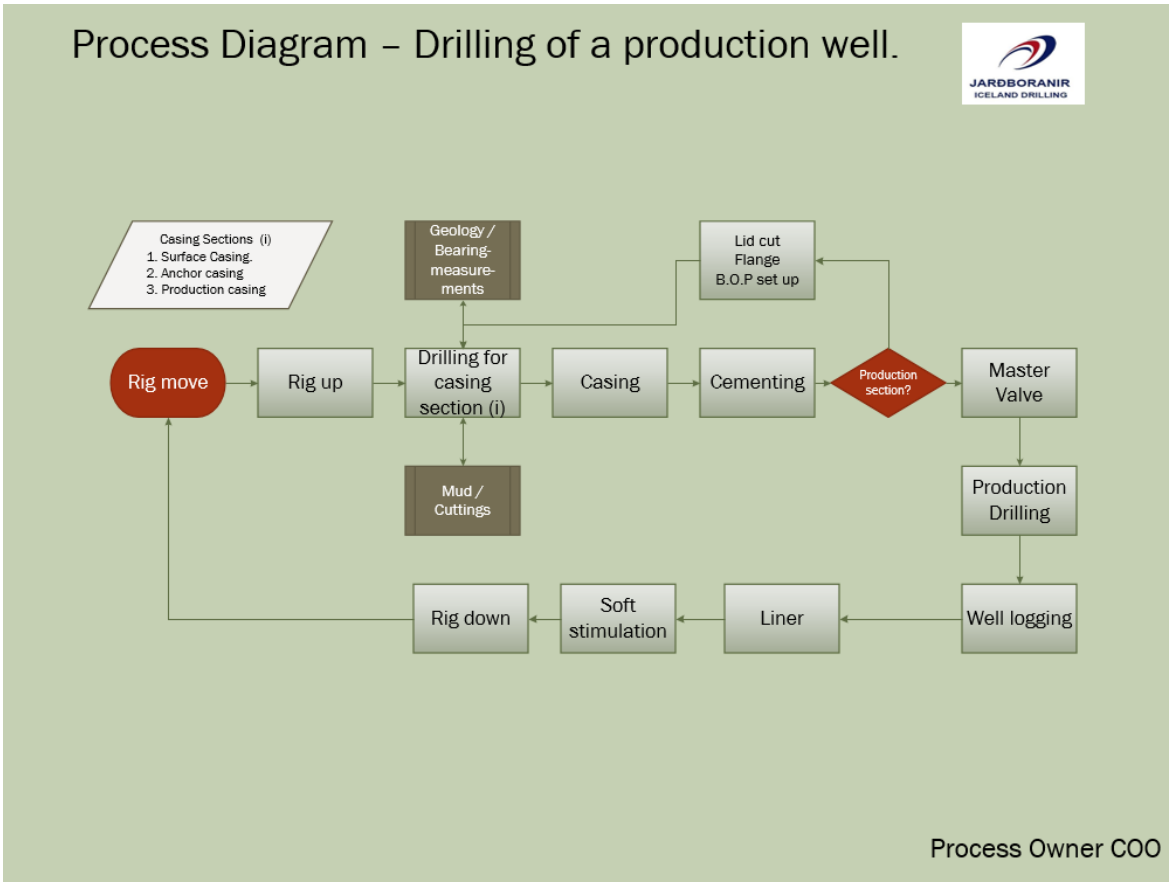


**Figure 1: Well drilling process diagram."**

IDC is an ISO 9001 certified company. The management of the drilling process follows a Plan-Do-Check-Act cycle. The major management system components for these parts, shown in the respective columns are:

**Table 1: Plan-do-check-processes in the IDC management system.**

| Plan | Do | Check | Act |
|---|---|---|---|
| Document control | Processes in figure 1 | Client inspections and audits | Incident investigations |
| Training & inductions | Assessments / Approval /Execution of change | Management and crew inspections | Non-conformance reporting |
| The SSP HSE plan, | Assessment on needs. Train to standard | Work permits | Improvements actions |
| Work Procedure Documents, SOP's | | Internal audits | Management of change |
| Subcontractor Control | | Crew and stakeholder feedback | |
| Site visit´s /verify local legislation | | Procedures in action | |

As every company knows, nothing happens without humans to carry out the work. IDC has a conventional Rig organizational structure. Figure two shows the structure for a recent project in SVG, which is typical for most projects.

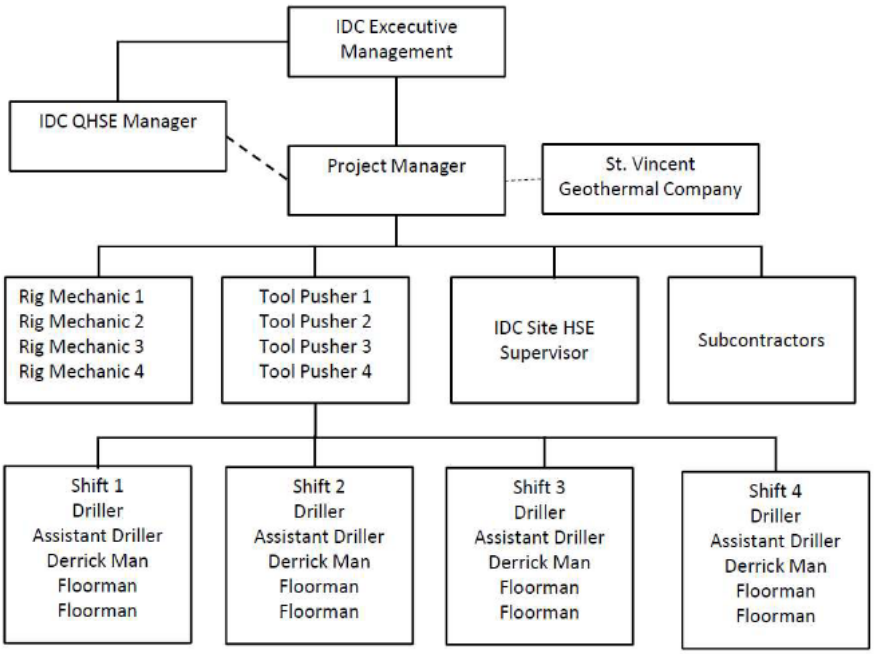


**Figure 2: A typical Onsite Organizational Structure for Drilling Operations, an example from (SVG).**

To monitor the performance of the management system it is vital to use leading, rather that lacking indicators. In a paper by *Leveson, 2014, A Systems approach to risk management through leading safety indicators*, demonstrates that there is a strong link between the assumptions that are made regarding safety controls and establishment of leading indicators to monitor. An example of this is that critical safety controls are the BOP's and the assumption that they are functional is critical for the safety of the crew. This is monitored by testing the BOP's regularly. The day there is not enough time to check the functionality and the people trust it will be functional when needed is the day the risk of the operation will start to migrate towards a serious incident. Monitoring and controlling leading indicators can reveal whether the operation is migrating towards higher risk.

The daunting task is thus to weave together all the part and requirements of the Standards and the Bidding documents to form a HSE management system that both involves the client and focuses on leading indicators in order to prevent accidents rather than reacting after they happen. Figure three shows the model that IDC has built in order to achieve this.

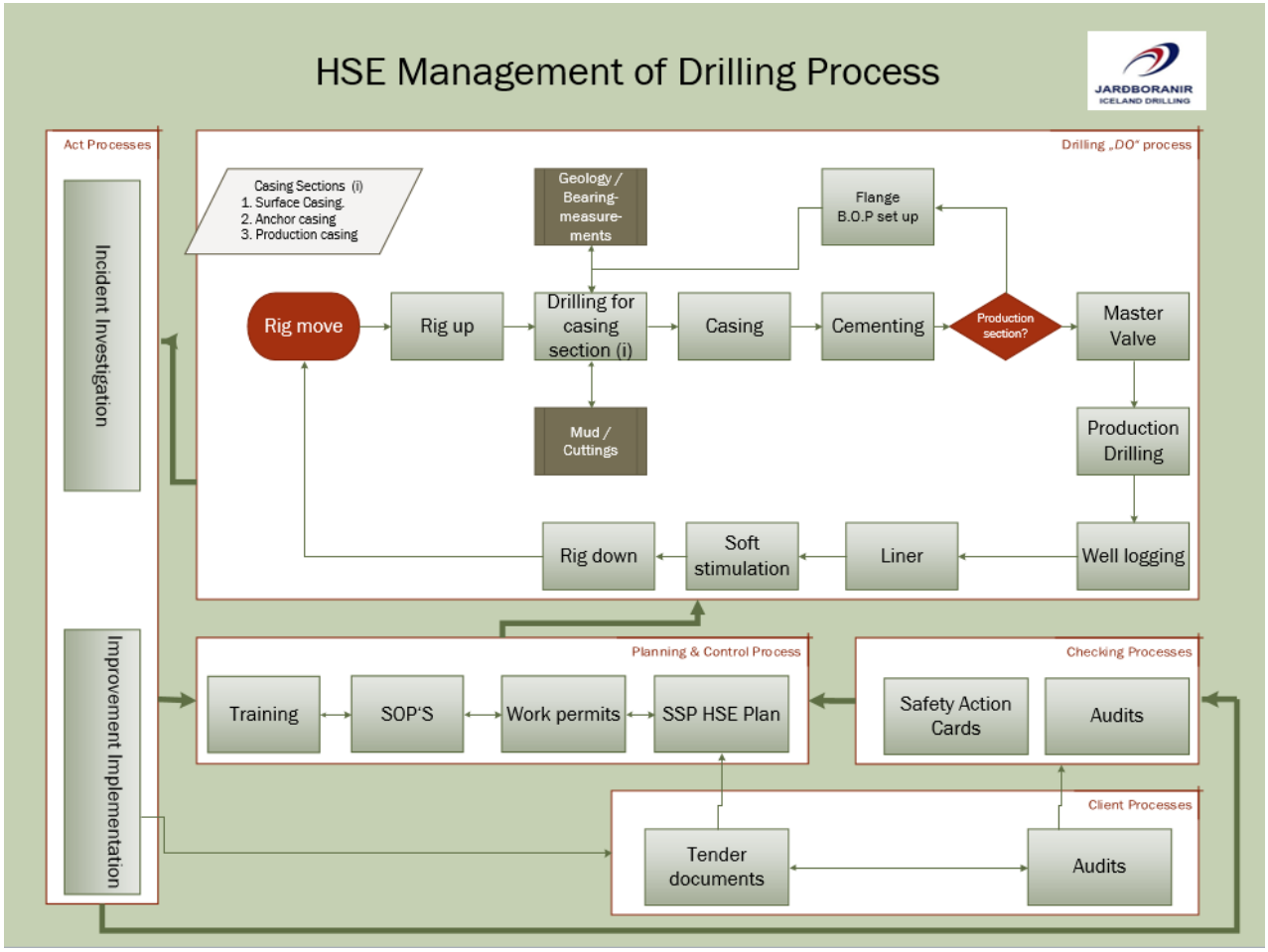


**Figure 3: HSE Management of Drilling Processes.**

Figure 3 shows the HSE management of the Drilling Process conforming with the ISO Standards requirements. The figure shows how the client processes are incorporated in the plan-do-check- act cycle and can be read in conjunction with table 1. This part is very important for the overall process of Geothermal project implementation. The central part of the client's role is to audit the drilling process and give feedback to the contractor who in turn can improve the process if needed. Also that the contractor is open and honest in reporting incidents and involving the client in the investigation and improvement actions. This involvement of the client is essential for the improvement of the bidding documents which will be used in the next project which completes the cycle.

An important part in implementing the safety controls is to have a HSE Supervisor on the crew. The main duties of the HSE Supervisor is to monitor the quality of the work permits and implementation of the associated Job Safety Assessments. Also to deliver important safety messages during shift pre-start meetings. HSE Supervisor manages also the safety action card system which is the main tool for feedback of employees and other stakeholders. The management of the improvement actions are done is close cooperation with the clients representatives.

The monitoring of the controls are done by regular audits performed by the HSE Supervisors, the local and the head office management. The result of the audits are reviewed by the management and incorporated in the improvement processes. The focus of the audits is to monitor the main assumptions for the performance of the HSE management system. This audits function thus as a leading indicator as whether the HSE management system is migrating towards higher risk.

Despite focusing on leading indicators, incidents can happen. In that case incident investigations play major part in the improvement processes. This cycle starts with a flash report which is sent to all in the company and the client. Following the flash report is an incident investigation that is led by the QSHE Manger and the HSE Supervisor on site. In case of serious incidents an investigation team is formed using both internal and external resources if necessary. The incident investigation is carried out in cooperation with the client.. The client receives the final report and corrective actions. This process ensures that the client is always informed of all incidents that happen, the casual factors and corrective actions. The learnings of the incident can thus be incorporated into the next generation of bidding documents to improve future drilling processes.

## 4. CONSLUSION

The vital role of project funding parties and project developers is now undisputed to create sustainable HSE management of drilling project projects that successfully prevent accidents and incidents. This especially true for projects that are executed in countries outside of the drilling contractors resident country.

The essential steps for the project developer and the contractor to form a sustainable HSE Management System is to follow same or similar accredited Standards that provide the requirements for the management systems, typically the ISO 9001, 14001 and 45001 standards. To communicate requirements outside the scope of the standards it is vital for the project developer to put the forth as clearly as possible in the tender documents. The client must also research local environmental and social conditions and put into an Environmental and Social Management System and deliver to the contractor as a part of the tender documents to set forth local requirements of HSE and Social management for the contractor to incorporate into his HSE Management System, typically the Site Specific HSE Management Plan.

Open and honest communication during the project execution phase between the client and the contractor is important for continuous improvement of Geothermal Development Projects and build trust. Participation of the client by auditing the drilling and HSE process, involvement in stakeholder feedback and suggestion systems and incident investigation is essential for the client to continuously improve tender documents and thus setting forth more clear requirements for the contractor to follow in future projects.

## REFERENCES

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