Dealing with geological Risk in BOT-Contracts –

Proposal for a supplementary modul for sub-surface works within EPC Turn-key-Contracts for BOT under International Competitive Bidding (ICB)

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Indroduction

BOT-schemes are actually widely used. The new FIDIC ”Conditions of Contract for EPC/Turnkey Projects” (Silver Book) meet the requirements for this kind of projects. However, these forms are not suitable if the construction will involve substantial sub-surface work or work in other areas which tenderers cannot inspect. An example for this would be hydropower development work with a large percentage of sub-surface works for caverns, water galeries, headrace tunnels and diversion galeries. Especially in South-East Asia there are many opportunities for the construction industry to engage in BOT schemes on the hydropower sector. India, for example, is interested in developing hydropower by BOT-schemes, but after years of failure - a result out of the inability to share ground risks between the involved parties - hydropower stays far behind the successful installation of thermal power plants with BOT.

In this paper, the following steps are suggested to handle these risks within hydropower–BOT projects:

- In the case of hydropower, expectations, design and detailed requirements are stipulated by the employer (hydropower projects normally are no isolated greenfield projects);
- Installation of a supplementary module for sub-surface works within EPC/Turnkey (because EPC contracts would not be suitable otherwise);
- Monetary precondition as a ceiling for the construction cost of the sub-surface work for the contractor (called Maximum Bidders Responsibility (MBR));
- Extraordinary ground risks (above the Maximum Bidders Responsibility) are borne by the employer (Portofolio technique is more applicable to the similar projects of the employer than to the different projects of the contractor);
- Tender price is based on the contractor’s expectations as to ground conditions and an extra risk charge for the gap between his expectations and the Maximum Bidders Responsibility (which is fixed by the owner).

These recommendations will force the parties:

- to stimulate innovation and competition and to get a suitable contract price and to punish speculation;
- to find the best contractor in International Competitive Bidding (ICB);
- to reduce suspension and completion risks;
- to install more hydropower, as the best an most powerful renewable energy source for growing economic.

The proposed model called ”K E F I R” applies BOT models in combination e.g. with the established FIDIC EPC turnkey contract to hydropower plants with substantial sub-surface works. The model deals with different expectations to geology (which are subject to competition) and provides fair risk-sharing under these circumstances. ”K E F I R” can also be applied to other construction contracts (within FIDIC EPC contract an additional model like ”K E F I R” is necessary in any case).

1. BOT-Models for infrastructure

BOT models are being used worldwide in the infrastructure sector. Many successful examples for toll motorways, toll bridges, thermal power plants, water supply plants etc. prove that this model is attractive for the private sector. However, only a small number of projects has been realised in the field of hydropower plants, and those are only projects without any significant sub-surface works (such as the Birecik power plant at the Euphrates river in Turkey).

1.1. BOT models for major sub-surface works

Projects with a substantial sub-surface works, in particular long diversion and pressure tunnels, shafts, and caverns (which are typical of high and medium pressure hydropower plants), as well as long road and rail tunnels include a high geological risk. Using the contracts and risk allocation schedules that have been usual with BOT models so far, such projects are mostly unattractive for private investors (as has been shown for example in India), because different types of infrastructure have different risk profiles (geological and hydrological risks).

To stimulate the application of the BOT approach to such projects, it is necessary to develop an approach that takes the special risk potential of such project into consideration. Furthermore, the current practice in most cases of negotiating with only one interested party is not only unsatisfactory for the owner but also detrimental to the national economy, and should be modified in the direction of more competition.

The developed model ”K E F I R” offers a convincing solution [7] for the handling of geological risks. Another objective to be realised with this model is the promotion of qualified competition that rewards primarily the bidders' innovation potential and know-how rather than their readiness to take risks.

1.2. System provider concept

The system provider concept offers substantial advantages for BOT models (likewise in the construction of hydropower plants and traffic tunnels). In that case, the bidder has the incentive to optimise the project over its whole lifespan in a holistic way. Under optimum circumstances, the concentration of the whole performance range of design, financing, construction, operation and maintenance in one hand means that the criteria for low lifecycle costs are already taken into account during design [2].

In most cases, the organisation form of the consortium has been selected for the construction of large hydropower plants. Due to the major part taken by construction work in the total package, such consortia have been mostly led by a construction company.

1.3. Risk sharing

In contrast to current practice, it is not sensible to let the bidder assume a project's unlimited risk from geology and hydrology because the resulting risk surcharge would make the project unviable. It is more sensible to have risk compensation - at least for extraordinary risks - compensated via the owner's project portfolio, and have the licensee assume geological risks, (and in the case of hydropower plants, also hydrological risks) only to a limited extent.

In general, the contractor is also unable to assume unlimited risks due to financing constraints, as doing so might exceed the scope of financing. The assumption of extraordinary risks by the owner - expediently, by forming a risk fund - also ensures that competition is not exclusively about readiness to take risks. Lower project risks make the project more attractive for competitors and lead to more extensive competition.

1.4. Standard contracts for BOT models

On an international level, the FIDIC EPC Turnkey Standard Contract (Silver Book) has established itself for BOT projects. That contract implements projects on a fixed-price turnkey basis and with a strict two-party approach, which involves a higher degree of risk being born by the contractor. In this, it deviates from the FIDIC principles of a balanced risk sharing (Red Book). It is therefore not suitable for projects with a large amount of sub-surface work. This is expressly laid down in the Silver Book. In contrast to geological risks, the EPC Turnkey Contract does not mention hydrological risks.

The following ”K E F I R” model has been developed in order to enable the application of this proven standard contract also to projects with a large sub-surface component. It provides a formula for fair risk-sharing between contractor and owner and a corresponding remuneration clause. Similar models have to be adopted for hydrological risks, which are currently not being developed by the authors.

The most important novelty is the introduction of an upper limit of risk expressed in monetary terms up to which the contractor bears the full geological risk. The cost and time consequences of risks exceeding that limit is assumed by the owner. This gives contractors as well as financing institutions a better overview of the risks and a better basis for calculation.

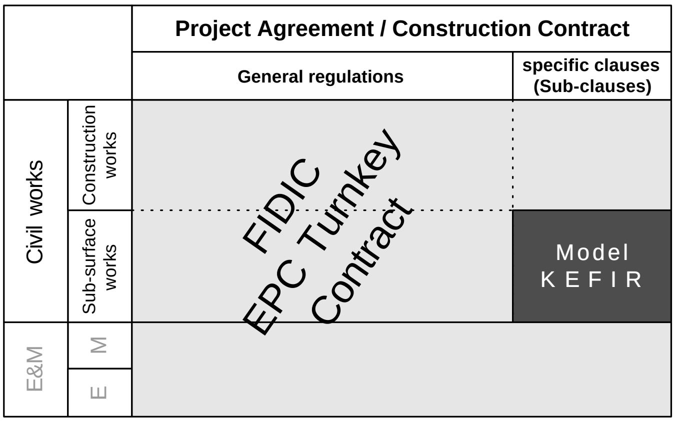

Figure 1. Modular integration of the "K E F I R" module into e.g. the FIDIC EPC Turnkey Contract for projects with sub-surface works.

2. The "K E F I R" model

In the following, this paper concentrates on the sub-surface works handled by the "K E F I R" model in the framework of e.g. an EPC Turnkey Contract.
The acronym ”K E F I R” stands for ”Kosten-Einbringung von Know-how–Finanzierung–Innovation–Risiko”, which means ”Cost–Input of know-how–Financing–Innovation–Risk”.
In this paper we are using the term ”contractor” instead of ”project company” or ”concessionaire” and ”owner” instead of ”host government” which are also often used in context with BOT.

2.1. Necessary basic conditions and requirements

The model described below assumes that there have been preceding pre-qualification proceedings (as is usual in general). The concept also assumes that the owner has a "concrete project image" of the project, which includes requirements for hydrological engineering, construction, energy management, and time-limits. This requires considerably more extensive preliminary work on the part of the owner in order to prepare the project for tendering - this includes development of the construction areas, geological research etc. This preliminary work and these basic conditions make sense in that they minimise many of the possible risks, and that the basic conditions (such as the location of barrages and tail race) are generally set in advance by feasibility studies and general layout plans.
Experience in India, for instance, also shows that without sufficiently extensive preliminary work by the owner, it is not possible to arouse sufficient interest from private investors [8]. For these preliminary works, the new Indian National Policy on Hydro Power Development [4] has been establishing a National Power Development Fund, which is financed by a new energy tax yet to be introduced, with the intention to accelerate the utilisation of the country’s large unused hydropower reserves.

2.2. Introduction of innovation potential and know-how

Part of this model concept is the stimulation of innovation and know-how. The current tendency in hydropower construction by BOT is towards purely risk-minimised projects. Often, there is no risk-sharing with regard to geological risks, and concession periods are too short, which means that there is no optimisation of lifecycle costs. An example for lacking lifecycle optimisation would be the use of an upstream free-surface channel instead of a direct connection through a pressure-tunnel. The tunnel would have advantages for future operating states (switching actions).
It is also an objective of the model concept that TBMs should be used in the long tunnels mostly situated on the critical path, thus reducing construction time with all consequences for lower financing costs and earlier revenues from power production.

2.3. Expectations of the parties

The owner defines his expectations by a functional description of the project, a geotechnical description (GBR - Geotechnical Baseline Report) on the basis of a geotechnical database (GDB) that is as independent as possible from the construction method. Furthermore, he informs the bidders of the qualitative results of his risk analysis and on that basis defines the financial limit to which prospective bidders have to bear risk. In our model, that limit is called "Maximum Bidders Responsibility - MBR".

2.3.1 Maximum Bidders Responsibility – MBR

The Maximum Bidders Responsibility (MBR) represents the financial limit from which it is the owner who will bear the costs caused by the geology. But below that, the contractor is responsible for his expectations to the geology, i.e., the competitive tender remains effective up to the MBR (surcharge over the lump-sum price).

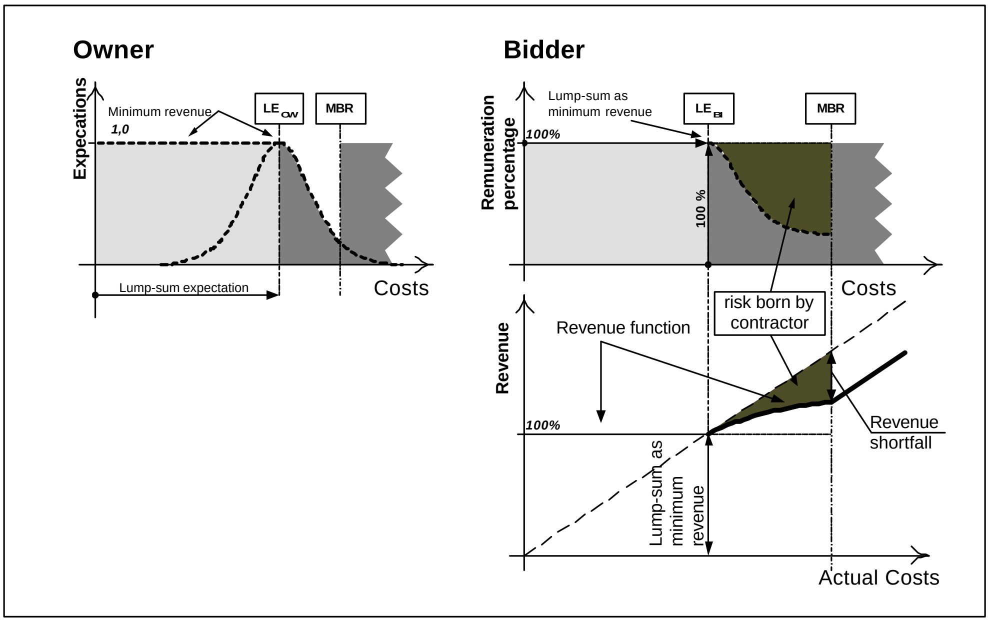

Figure 2. Graphic display of the remuneration and risk allocation under the "K E F I R" model concept.

2.3.2 Lump Sum Expectation

The owner determines his Lump-sum Expectation (LE_{OW}), but does not tell it to the bidders. The licence bidders in turn determine their own Lump-sum Expectation (LE_{BI}), which represents a minimum revenue (in the sense of "Attributable Construction Costs - ACC" for the project). The area of difference between MBR and LE_{BI} is integrated into the tender by way of remuneration percentages.

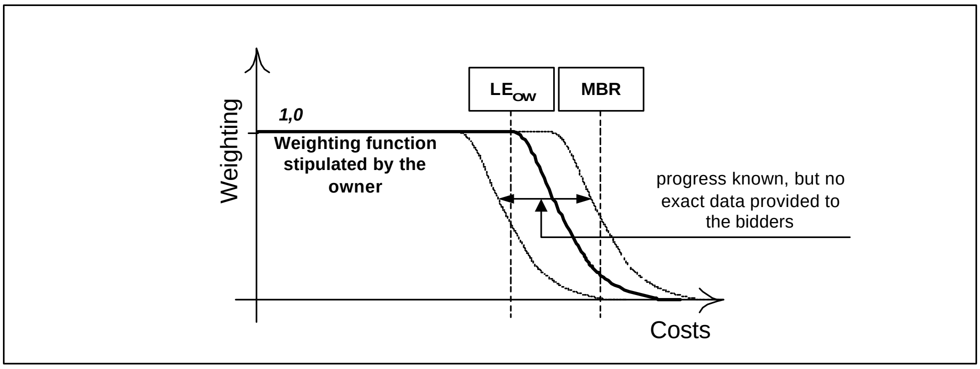

Figure 3. The owner's estimation of costs and risk analysis results in his LE_{OW} (Lump-sum Expectations of the Owner), as well as in the progress of his cost expectation. The owner informs the bidders of the qualitative progress of this cost expectation (= weighting function in assessing tenders) and of the Maximum Bidders Responsibility (MBR → risk limit).

2.3.3 Special cases

It is possible that there are cases in which the MBR has been incorrectly stated by the owner. If the MBR has been stated to low, the incoming tenders of bidders will lead to a reconsideration of the project idea. A MBR that is too high will most likely lead to relatively high remuneration percentages at the beginning of the area of difference, which are integrated into the assessment of tenders and only become relevant in the case of effective risk. However, speculative bidders would suffer a high shortfall of revenues until reaching the MBR. In any event, setting the MBR is an instrument of control for realistic price determination.

2.4. Prevention of speculative tendencies

The model concept supports realistic price determination with a clear allocation of risks and a limitation of risks by a gain/pain mechanism.

- The bidder's Lump-sum Expectation (LE_{BI}) represents a minimum revenue, even if conditions prove better than expected (bonus). In this case the contractor enjoy a higher profit;
- Risk is borne by the contractor up to MBR, regardless of the nature of the event (exceptions are possible in special cases), assumption of risk is subject to competition, too optimistic (possible speculative) expectations in competition are reduced by a pain/gain mechanism during implementation;
- Financial limitation of risk → lower risk surcharges necessary, easier financing → wider range of interested parties;
- Generally lower risks due to more preliminary works.

2.5. Target Costing elements

The model shows elements of "Target Costing", two targets being defined:

- MBR as the limit to which risk is borne (set by owner);
- LE_{BI} as "upwards-adjustable Lump-sum price" or minimum revenue (bonus mechanism);
- The bidders offer a remuneration percentage for the area of difference in accordance with their risk analysis and entrepreneurial decisions (tender by bidder). The schedule for allocating any additional costs to the Lump-sum price or lower costs compared with the MBR is not fixed as in a GMP contract but is subject to competition by the bidders. If the actual costs are situated in the area of difference, the contractor must bear the revenue shortfall in accordance with the curve of the remuneration percentage offered by him.

2.6. Determination of best bidder

Since the expectations of owner and bidders as to geology at that time are of a subjective nature, a method of assessing tenders under the requirements of innovation, know-how and preventing speculative tenders must be defined.

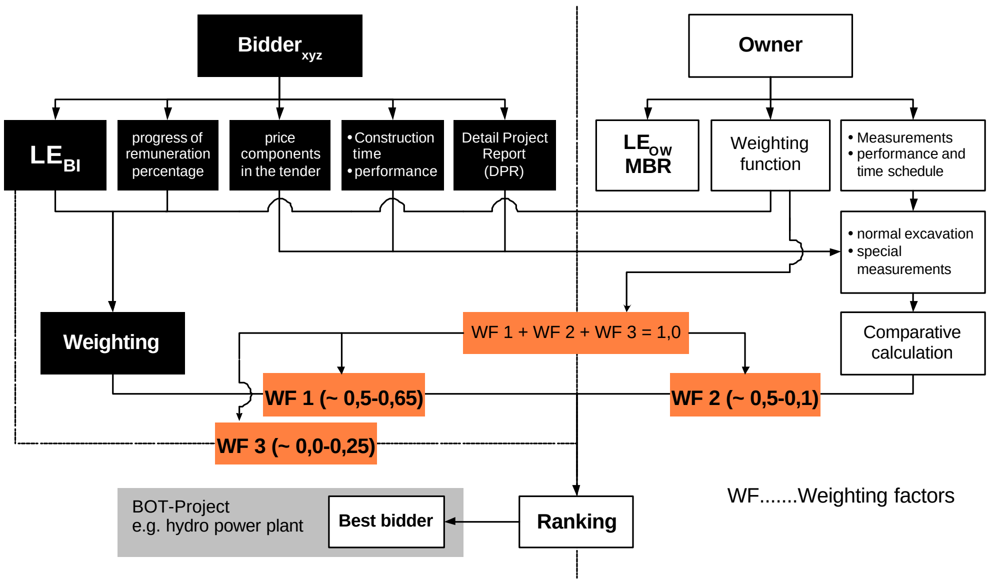

Figure 4. Diagram for determining the best bidder with weighting of relevant tender components.

The best bidder is therefore determined from weighting the following tender components:

- Bidder's Lump-sum Expectation (LE_{BI});
- Curve of remuneration percentage in the area of difference;
- Comparative calculation of the owner's expectations, which are determined using the bidder's prices on the owners geological expectations;

- Comparison of guaranteed performance and the connected time-dependent costs.

At that time, the conditions encountered in excavating are not known; it is therefore impossible to decide objectively which expectation is correct.

The weighting factors must be primarily set in a project-specific way. Furthermore, specific weighting can be used to influence the amount of the Lump-sum price in relation to other tender components.

2.7. Self-regulation mechanisms

If there is a negative deviation of encountered conditions from the owner's as well as the contractor's expectations – i.e., if conditions are substantially worse than expected - the MBR is exceeded. The contractor must already bear his revenue shortfall (including the geological risk up to MBR).

However, the worse conditions become, the lower the pro rata revenue shortfall of the owner gets. Assuming that his prices cover his costs, his situation is becoming better and better, the revenue shortfall is thus mitigated - following the idea that if conditions are totally different from what both parties assumed it should not be the contractor who should bear the geological risk. Indirectly, this promotes cost-covering prices because the tender should remain effective if possible. This requires a separate accounting of overheads, one-time costs, and time-dependent costs [3][5][6].

2.8. Monitoring of construction

For sub-surface works, monitoring of construction by the owner is indispensable. A joint recording of the actual event is absolutely necessary to determine the "Attributable Construction Costs". These costs are compared with the parties' expectations and then subject to the described regulation mechanism.

2.9. Dispute resolution

In order to avoid lengthy legal disputes, the model should be accompanied by a multi-stage construction monitoring and dispute resolution system that meets the requirements of sub-surface works. This mainly includes - shortened decision paths and on-site decisions.

3. SUMMARY

It is the objective of the "K E F I R" model concept to increase the number of BOT projects in the hydropower sector. For this purpose, the risks specific to hydropower and sub-surface works must be reduced for the contractor (project company).

On the other hand, the innovative power and the know-how of the bidders should be stimulated.

To that end, "K E F I R" follows the principles of a sensible allocation of risks depending on the spheres of influence. It ease financing problems by implementing a financial limitation of geological risks (MBR).

The expectations of bidders into the geological conditions are subject to competition but controlled by a gain/pain mechanism to reduce speculative tenders because the contractor is responsible for possibly over-optimistic expectations (revenue shortfall up to MBR).

Due to the risk reduction, there will be a more extensive competition among qualified bidders, with higher chances of project realisation and lower project completion risk.

Weighting of different tender components strengthens the best-bidder principle as compared to a pure lowest-price-bidder principle and does not reward the readiness to take risk.

If conditions are totally different from those predicted, the contractor is responsible for his tender up to the MBR, but then the revenue shortfall percentage is reduced as actual construction costs increase.

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