Part Sheet Usage in The Assembly Process of Small Hydro Power Plants

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Abstract: - Europe leans towards cleaner and more efficient energy production. The Renewable Energy Sources Directive of European Union sets mandatory national targets for renewable energy shares of final energy consumption in 2020. This fact makes the investments into renewable power not only inevitable, but also viable because of the guaranteed feed-in tariffs. These facts, together with the financial burden of mega projects in hydro power business made an investments into small and micro hydro power plants a viable option. Since each day a power plant is not running produces a noticeable loss in the power output which consequently results into a financial loss, each action, that can make a power plant feed the electricity into the grid sooner is highly valued. To ensure a faster assembly time a series of work sheets have been developed, these shall make the turbine assembly faster, downtimes shorter and the whole process more efficient.

Key-Words: - Part sheet, small hydro, hydro power, Slovakia, assembly, efficiency

1 Introduction

The current development is characterized by continuous growth of requirements for the amount of consumed fuels and energy. [1] From 1992 onwards, renewable energy has become one of the top priorities for the governments in all the European countries due to the increasing global concerns about the climate change and scarcity of fossil fuels. Concerns about the energy security and climate change are enforcing significant changes in how energy and electricity specifically, is generated, transmitted and consumed. Since then, a series of formal and informal policies, directives, legislations, etc. Have been developed to encourage the use of renewable energy in order to reduce emissions of greenhouse gasses, to decrease the energy consumption through out the European Union, and to increase the energy efficiency.

This means that the European countries are already aware of the consequences of using fossil energy sources. For instance, in the UK the 2003 " Energy White Paper " contains a commitment to reduce carbon emissions by 60 % by 2050, in comparison to 1990 levels, and aims for 20 % of total electricity. Such targets require that low carbon technologies for generating energy, (including renewable energy technologies that generate electricity from wind, sun, water, biomass and sea), become common, rather than " alternative ", as is currently often the case.

Nevertheless, many studies show that in direct contrast to the political discourse, the energy consumption in majority of the European countries is mainly based on fossil fuel use, which is increasing steadily. That means that the European countries are only slowly progressing towards the implementation of various approaches to save the energy by using renewable energy technology. Thus, a mission to create a public awareness is not only important, but even necessary in this regard. [2]

The targets of the European Council are strict and stipulate increasing the use of renewable energy by 20% and reducing gas emissions at least 30 % below the level of 1990 by 2020. According to the European Council, Slovakia should increase the share of renewable energy to 14 % of end-use consumption by 2020. According to the forecast of European Commission, Slovakia is expected to be in surplus of 1.2 %, what means that 15.2 % of the end-use consumption by 2020 should be generated by renewable energy. [3]

The renewable energy technologies for energy generation are diverse, encompassing solar photovoltaic panels, wind turbines of different scale, designs and on offshore location, energy from waste plants, biomass fuelled plant at scales from small combined heat and power plant to large scale power station, hydro schemes and ocean technologies (e.g. tidal and wave devices). Since each technology captures different natural resources in different ways, the environmental, economic and social impacts of each technology vary. Thus, the need of assessing social acceptability of renewable energy technology is fundamental for understanding a community's social perspectives in terms of using renewable energy technology and climate change issues. [2]

But before we continue any further, it would be wise to define the main terms.

For all practical purposes, energy supplies can be divided into two classes:

- *Renewable energy* – „Energy obtained from natural and persistent flows of energy occurring in the immediate environment". An obvious example is solar (sunshine) energy, where ' repetitive ' refers to the 24-hour major period. Note that the energy is already passing through the environment as a current or flow, irrespective of there being a device to intercept and harness this power. Such energy may also be called *Green Energy*, *Sustainable Energy* or *Alternative Energy*.

- *Non-renewable energy* – "*Energy* obtained from static stores of energy that remain underground unless released by human interaction ". Examples are nuclear fuels and fossil fuels of coal, oil and natural gas. Note that the energy is initially an isolated energy potential, and external action is required to initiate the supply of energy for practical purposes. To avoid using the ungainly word 'non-renewable', such energy supplies are also called *finite supplies* or *Brown Energy* [4]

2 The Importance of RES in Slovakia

Slovakia offers significant future potentials for several kinds of RES options which are waiting to be exploited in the forthcoming years. In contrast to above, current RES deployment is at a comparatively low level. Currently, the key support instruments of RES-E in Slovakia is a feed-in tariff. The Regulatory Office for Network Industries sets feed-in tariff rates annually, taking into account the index of national core inflation. The revision of feed-in tariffs every year however brings some uncertainty into the RES-E market. On 19 June 2009, Slovakia adopted a new Law on the Promotion of RES and High-Efficiency Cogeneration in order to foster the attractiveness of investments in RES technologies and to meet the country's EU targets. Under this new support scheme, a feed-in premium will be available for RES-E producers. The fixed tariffs is determined for different types of RES technologies on the basis of installed capacity and the date of commissioning the plant. The feed in tariff has been determined in such way that the pay-back period is 12 years. The new support scheme is available for the following RES technologies: hydropower, solar, wind, geothermal, biomass, biogas, sewage gas and bio methane. The feed-in premium scheme will be based on a premium payment on top of the basic electricity price.

A producer of RES-E will be entitled to a premium for 15 years after the initial operation, reconstruction or modernization of a power plant. RES-E producers have the right to a premium if the total installed capacity is up to 10 MW. In the case of wind energy, producers have right to a premium if the total installed capacity is up to 15 MW. [5] Because of these reasons, building small power plants is becoming more and more attractive investment. Construction of additional large hydro power stations now seems unlikely, due to both to environmental concerns and to the high costs of providing under-served rural areas and mountainous communities with additional electricity supplies via the construction of large dams.

In these circumstances, the construction of additional small hydro stations could be a more cost efficient and less environmentally intrusive solution. More than 190 small hydro power plants are currently in operation in Slovakia. The construction of additional small hydro power plants by Slovakia's electricity generation company (and owner of large hydro power stations, Slovenske Elektrarne), is therefore anticipated – particularly in

the Vah river basin. [6] Just recently a small hydro power with an installed capacity of 0.315 MW plant has been connected to the grid by Slovenske Elektrarne. [7]

Because of the above mentioned facts it is crucial for companies producing the technology for small hydro power plants to have an operative knowledge management, where they can capture the company know-how and drive the company to better results.

2.1 How to Ensure Improvement in Assembly Process ?

The demand for small hydro power plants has been increasing in last few years. Companies producing turbine equipment need to react to the demand faster and organize the manufacture better than before. The rise in the manufacturing requires also an increase in manpower. Manufacture and assembly of turbines however is a process that requires both technical thinking and skills.

Hiring employees to the manufacture that have skills with turbine equipment is not an easy task, and employers often have to go below the set requirements just to get the labour force. Therefore a set of – so called "part sheets" have been developed to make the work easier to the new hires (and also to the skilled workers) and ensure the high quality of the assembly process. Since turbine manufacturing is in no meaning a serial manufacturing, but each piece is a "prototype" these part sheets will vary from project to project, but the principle and template remain the same, to ensure a kind of standard.

These part sheets are also supposed to make the logistics simpler and more accurate. As each of the part sheets is showing all the required components, those can be brought in one package to the place where they are supposed to be assembled. That way all the required components should be on the spot for the employee to work with. That not only reduces errors, but also decreases assembly time, since the worker has all the required components next to him and does not have to look for them around the manufacture.

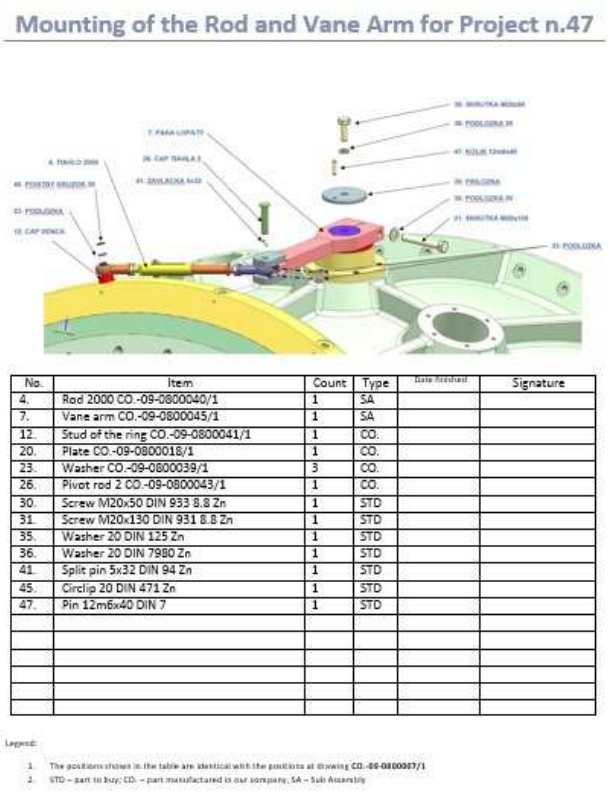
Part sheets shall help to reach quality goals, environmental improvement goals and should become part of the annual business plan, with performance reviews to track progress and to encourage environmental excellence [8]

Part sheets can be also considered as a form of reengineering. [9]

3 Part Sheets used in Manufacture

As mentioned before Part Sheets contain a list of used stocks. But their outline is not only formed by that. They are formed by 2 main parts:

- The 3D part, where the subassembly is shown in an exploded view together with all the stock names indicated.
- A list of all the stock used with their serial number, item name, item count and its type.



No.	Item	Count	Type	Date finished	Signature
4.	Rod 2000 CO.-09-0800040/1	1	SA		
7.	Vane arm CO.-09-0800045/1	1	SA		
12.	Stud of the ring CO.-09-0800041/1	1	CO.		
20.	Plate CO.-09-0800018/1	1	CO.		
23.	Washer CO.-09-0800039/1	3	CO.		
26.	Pivot rod 2 CO.-09-0800043/1	1	CO.		
30.	Screw M20x50 DIN 933 8.8 Zn	1	STD		
31.	Screw M20x130 DIN 931 8.8 Zn	1	STD		
35.	Washer 20 DIN 125 Zn	1	STD		
36.	Washer 20 DIN 7980 Zn	1	STD		
41.	Split pin 5x32 DIN 94 Zn	1	STD		
45.	Circlip 20 DIN 471 Zn	1	STD		
47.	Pin 12m6x40 DIN 7	1	STD		

Legend:

1. The positions shown in the table are identical with the positions at drawing CO.-09-0800037/1
2. STD – part to buy; CO. – part manufactured in our company; SA – Sub Assembly

Figure 1 Part sheet example

From the top to bottom, one can see:

- Identification of the subassembly and the project
- 3D exploded view of the subassembly
- List of items, item count, their type, date of their assembly and the signature of the responsible employee
- Legend

3.1 How to Ensure Improvement in Assembly Process ?

In this paragraph, we would like to demonstrate how part sheet have been used for the assembly of outer and inner gate barrel with wicket gates.

Part sheet for this assembly (we only show the exploded view and few steps while the assembly process to retain this article in reasonable length):

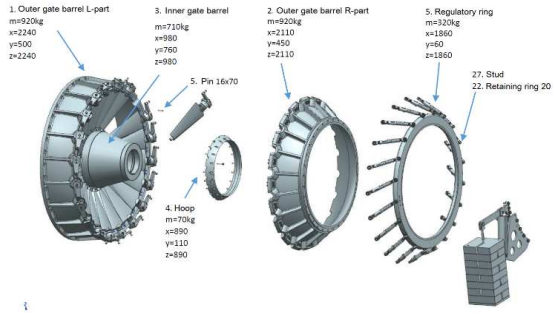


Figure 2 Part sheet used for assembly of the outer and inner gate barrel

Step 1 Insertion of wicket gates subassembly to the left part of outer gate barrel.

Figure 3 Left part of the outer gate assembled with the inner gate barrel with wicket gates

Step 2 Putting on the right half of the outer gate barrel to secure the wicket gates in their position in order to be able to insert pins. And the regulatory ring

Figure 4 Right half of the outer gate barrel

Step 3 Taking the right half of the outer gate barrel and sliding it on the subassembly of left part of the outer gate barrel

Figure 5 Assembly almost finished

4 Conclusion

The usage of first six of these work sheets has been launched several months ago. Significant time savings have been observed using mainly work sheets where more complicated assembly parts are shown (wicket gate rod, runner, etc.). The next stage will be aimed to quantify all the impacts of these work sheets. Time savings need to be quantified, and the part sheets, with small changes, need to be used in different projects to evaluate their versatility. These part sheets shall be useful in three departments. In project management department to have a „big picture“ while assembly period is in progress. In the logistics department while planning the material flow. And most importantly in the

manufacture, where these should contribute to shorter assembly time, less error rate and decreasing the downtimes. These part sheets also play an important role in the company know-how, since each improvement in assembly, whether it is a reduction in material used, or reduction of components that leads to the same or a better performance is registered in a part sheet and leads to part sheet improvement. Therefore the next project can be done in the same or improved quality. In this case even the loss of a skilled labour force, does not necessarily mean the loss of know-how.

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