

Proc. 447: Maintenance in Manufacturing Plant: Turnaround Planning and Follow-Up,

by: J D Pedersen.

Discussion following the presentation of the paper:

Pan Orphanides, Consultant, Greece:

Another important aspect I think in this pre-planning phase is the possibility of innovation, because most of the time the pre-planning is based on a stereotype. People have used it successfully in the past and they repeat it. From my own experience I can give you an example - we had to replace a huge 2.5 m by 10 m waste-heat boiler which had run with a lot of risers and downcomers to produce high pressure steam. We asked the manufacturer to give us the planning for this replacement. He gave us his plan which required four weeks. So then we started asking why it should take four weeks and began chasing the critical path. We ended up with a plan taking two weeks, but using a completely innovative concept - not taking piece by piece out and putting piece by piece in and weld but prepare everything in advance as an entirety, including the brick lining and even the curing of the brick lining, and installing it. This was something which was out of the question for the manufacturer because they were not experienced in doing these sorts of things. Do you agree that this is a very important consideration?

Jan Pedersen:

Yes, I should have mentioned it because I fully agree that you should always reconsider whatever you did in the past.

Pan Orphanides, Consultant, Greece:

Another important issue is giving incentives. A contractor may say that he needs two weeks or ten days working for a phase, but you know that this is your critical part and by reducing it you could save a lot of shutdown time. If you introduce incentives to finish the work in a shorter time he will find ways of doing it if the right incentives are given.

Jan Pedersen:

But here you have to use diplomacy you know if the guy is working on a lump sum basis and you tell him you need two more people there in order to complete the job, he would say 'I would need more money'. So you have to convince him that this job actually needs two more men without him actually asking for money because you have to convince him that it's the right thing to do. That could be rather difficult.

Klaus Schübel, SKW Stickstoffwerke Piesteritz GmbH, Germany:

I think the turnaround or maintenance in an ammonia plant or in a refinery is not very different. How much time before starting the turnaround do you begin your planning, and how frequently do you carry out a general turnaround in a refinery - every two or three years, five years?

Jan Pedersen:

The question of when we start the planning is a difficult one of course because we like to start maybe three months ahead of the turnaround. However usually the timing of the turnaround is determined by external factors such as some kind of production situation or supply situation, etc.. In some cases though you could say 'it has to be in this period'; then the period is fixed and then you can start planning maybe two or three months ahead. We would like to have all the jobs identified a month before. We like that. But the actual situation is that we get jobs even up to the very start of the turnaround. We know that but we still like to have them a month ahead. We never get all of them of course!

Considering the frequency of the turnaround; in Denmark we have a statutory requirement for inspection of pressure vessels every four years. So every four years at least we have to have a turnaround, opening all the pressure vessels, but for pressurised piping the inspection has to be every six years, that means off-stream inspection. We are working hard trying to persuade the authorities to extend the pressure vessel period from four to six years so that we only have a turnaround every six years and we actually succeeded in having an extension in the old refinery from four to six years. Based on a very detailed analysis of each component, each vessel was analysed historically and from the actual current operating situation. This was in fact my job for about two-and-a-half years after I retired; I went through this oil refinery and we discussed it with the authorities and we got their approval. So we hope to be able to continue with the six years but it hasn't been finally confirmed yet.

Peter Baldwin, retired consultant:

Now that firms, particularly smaller companies, tend to have got rid of a lot of their supernumerary staff for economy reasons, if you are faced with planning and going out to a contractor and you have to build up a specification for the contractor, how can the smaller firm find a consultant with the necessary experience like you who will come in and do this because it does seem to me that in your process this business specifying the work in advance is particularly important. Do these people exist?

Jan Pedersen:

I think they do. Personally I don't know of any company which has specialised in the actual planning of turnarounds. I know there are people such as a scheduler or a cost estimator, that's all I've seen. But for overall planning - I am sure that somewhere in Europe, for instance the area around Rotterdam in Holland, where there is a huge concentration of chemical plants, I'm sure there must be companies there who actually specialise for the reasons you mention. But generally speaking the turnaround organisation is taken from your own company and very often the refinery is part of a bigger company which usually includes a number of refineries or chemical plants and you can recruit the organisation from those plants if necessary. I think it's seldom that you have only one isolated refinery or item of plant actually, at least within the refining section.

Peter Baldwin, *retired consultant*

I realise that in the case of the large organisation but I was thinking of the smaller organisation with maybe one big complex in one country, but no associates. My second question is about matching the turnaround management and safety. How do you ensure when the plant is closed down that the overall management of the safe state of the equipment is maintained so that when the contractor comes onto the site the proper transfer of responsibility from the operating staff is made? Similarly on completion, how do you ensure when a contractor has finished that the responsibility for safety and operation of the plant is clearly handed over with certificates and so forth, so that the overall responsibility passes from one party to another in a clear-cut way, which seems very important to me.

Jan Pedersen:

We have quite an elaborate system of permits. We have two sorts of 'Hot Work Permits' and 'Cold Work Permit'; this means that in order to start work you have to have a permit. You can't just start cutting into process equipment or lines, or even driving a truck through the process area without a permit. You need several kinds of permit, for example you also need a permit to enter a vessel and there have to be people standing by outside the vessel in case anything should happen inside. When you have completed a job you have to sign the closing permit. After inspection there is an elaborate system for who is supposed to sign, the process superintendent has to sign and the mechanical superintendent has to sign, etc. to make sure that everything is done and in good order.

Peter Baldwin, *retired consultant*

I'm afraid I haven't made myself clear because what you are talking about is what we call here in the UK 'Work Permits'. What I'm referring to is the overall responsibility. There should be a very clear-cut handover it seems to me, between the contractor finishing and the process people wanting to start up that the whole affair is ready to go and it's a very clear handover responsibility from one management to the other.

Jan Pedersen:

I don't think we have any official written document, but I understand the importance of what you say. In fact however a refinery is not often started up as one unit. Usually you start one section and then you start the next one. This is why I mentioned that we actually complete the turnaround within the systems and sub-systems so that a system can be completed, and be pressurised or whatever, and then it's ready for operation. Then the next item, and so it goes piece by piece. This is again handled by the process and the mechanical people.

Pan Orphanides, *Consultant, Greece:*

I think in large turnaround projects in refineries in chemical complexes, costing in the millions of dollars, there are procedures that are well known, such as

mechanical completion tests to pass the responsibility from the contractor to the operating personnel. I am sure in this kind of turnaround contract there is definition of the procedure for a takeover in the mechanical completion tests which have to be done to prove that a section is mechanically completed before the next phase of pre-commissioning can start.

Jan Pedersen:

We do have procedures for that. We have for example one procedure where the mechanical supervisor goes through the items with the contractor and then he signs the paper that this has been inspected and found to be in good order or maybe there is a job list which has to be completed before the job can actually be handed over. Then finally when the job has been satisfactorily completed the form can be signed. After that the mechanical supervisor goes to the process people after checking out the system and says this system has been checked out and in my opinion it's okay. Then with the process people they sign this document together and then it has been formally handed over to the process people. However this is not just one document, it's usually done system by system, not for the whole refinery for the whole turnaround as one.

Doug Wallace, *Synetix, Billingham, UK:*

We've had quite a lot of experience over the years and I have been operating ammonia plants for thirty-odd years so have been through many turnarounds! It has been asked if there is any help available for turnarounds, particularly for smaller companies. ICI now has an engineering group called Utec and they offer a full turnaround support, right through from the pre-turnaround phase through to the completion of the actual turnaround.

Another point was the handover of equipment and this is extremely important for the work that has been done on the turnaround, especially if there has been a major modification to a vessel or the piping. The system we used to run was that the contractor would say he'd finished the job. The next stage would be one of the plant engineering team inspecting it and saying "No, you haven't done that" or "Okay it's finished". Then the next stage would be the inspection by the process team and then eventually it would be handed over and the Permit to Work would be signed off. At the beginning of the turnaround the equipment is given to the contractor on a Permit to Work system, having been prepared for the contractor: safe, isolated, etc. You have mentioned audits - people going round auditing work that's being done. We didn't just involve two people, but would try to involve the whole of the ICI management team in doing audits on the different parts and systems.

I'm very interested in safety promotion as that's extremely important during the turnaround phase. I would ask what sort of things you do for safety promotion.

Jan Pedersen:

Referring to auditing, we actually use everybody from the refinery manager down to the supervisor for auditing, and these form two-man groups who regularly pass through the plants, looking and maybe giving advice. So this is a

function which involves not just a few people - it's actually the whole organisation - and it is involved in safety monitoring as well. Prior to that each contractor - whether he is an unskilled labourer, a supervisor or an engineer - gets safety instruction which usually takes about an hour and we show them a video on the basic and essential safety aspects of the work. They also get a folder, in English, which also tells them the basic safety rules they should obey. Then we have this continuous follow-up, even prior to the turnaround because usually there is a lot of prefabrication work being done at the refinery, particularly for piping for instance, which is why it's necessary to have a safety monitoring system in place prior to the turnaround to make sure everything is going as it should and to get them introduced to our way of thinking and getting used to being safety-minded which is sometimes very difficult.

Doug Wallace, *Synetix, Billingham, UK:*

You mentioned in your paper about re-evaluation of the turnaround but you didn't actually talk about it. Re-evaluation and assessment is so important.

Jan Pedersen:

I should have emphasised that re-evaluation is very important, thank you. Unfortunately it is not always done efficiently, because everybody is eager to get on with other jobs as soon as the turnaround has been completed. It is essential to get people together to evaluate what happened, what was good, what was bad and what should be improved next time, etc. Another thing I should mention is the updating of the documentation. Handing over the job is difficult because if the contractor has to do some of this updating the job isn't finished until he has done it and sometimes that can take quite some time to do. Also we can't complete the job until the process people have accepted the plant and that's why it's so important that there is a system where they can follow right after the mechanical people, so that the mechanical people don't have to wait maybe one or two days until the process people have had time to check out the system because the contractor is waiting to get his money and get out of the plant. I think we have found a fairly good solution in the system we are using now.

Doug Wallace, *Synetix, Billingham, UK:*

I have a good example as well on the ammonia converter. We did the Casale retrofit on the ammonia plant at Billingham in 1989 and the ammonia catalyst lasts perhaps eight or so years, so when we came to a turnaround in 1997 all the people that were there in 1989 have gone. Luckily because we had carried out a good re-evaluation, there was a wonderful report on how it was done in 1989. It made the job so much easier; it's a good example.

Jan Pedersen:

I now recall an example of considering other ways of doing things. We had to clean the vacuum tower which is quite a big vessel and we used to take at least ten or twelve days to clean it. Then we found a contractor in Norway who was doing it a quite different way and we managed to cut down from these 12 days

to 26 hours. So that's an example of what can happen if you try another way of doing it.

Anon:

An unclear question on the use of contractors in the turnaround.

Jan Pedersen:

I can only tell you that, because of our limited manpower, we are forced to use contractors almost exclusively for turnaround jobs. I think 90% or maybe 95% are contractor people, so basically it's only the supervisory forces that are Statoil staff - supervisors, key personnel and planners, and even planners could be from contracting companies. However we have a lot of instrumentation of course and continuous analysers and this equipment is normally handled by our own people but in the last few years we have even had to have people from outside helping us to maintain this equipment. We use a very high percentage of contractors but fortunately even in Denmark, which is a small country, there are now companies which have developed an expertise in most of the special areas, mechanical, civil and structural routines and also on instrumentation and electrical maintenance. Then of course there are companies from outside with experience; you can actually ask them to do almost any job and they will come and do it for you.

Kish Shah, *Terra Nitrogen UK Ltd, Billingham, UK:*

Can I look ahead five or ten years at the whole process of interacting with the contractors and with your own people employed the training and safety aspects and so on? Should we not be moving to a new technological revolution in terms of modelling the plants and being able to talk to the contractor sitting in the office, actually looking at the plant on the screen, and saying to him for example "this is where we want to break the line"? Has any work been done in this area? I was extremely impressed in one or two accident investigations I was involved with to find that, despite the plant being destroyed, they were able to construct a model of the plant in the computer using the special software and could turn the whole vessel in three dimensions. Should we be moving towards this sort of computerised model, and for an existing plant that could be reasonably easy, so that you sit down with the contractor and show him on the 3-dimensional model what is required. I think it would probably be cost-effective. I wondered if anybody has gone into this area and have you given any thought to that?

Jan Pedersen:

I believe Ed Kilian should answer that one!

Ed Kilian, *Continental Engineering, Amsterdam, Netherlands:*

We have a client who is interested in including these aspects in a new plant, right from the design stage.

John O'Grady, *Irish Fertiliser Industries, Cork, Ireland:*

I have been associated with ammonia plants either on production or the engineering side for about 20 years now and have experienced many turnarounds; there are a couple of points that I would like to make that I think probably haven't been covered. The planning of the turnaround is usually based on all the work known to be required, but of course what invariably turns up during a turnaround is the unexpected and I think it's very important to include in the planning process the possibility that you may find something that you don't know about. Sometimes they can be small items that take a day or two to fix but many people I am sure have experiences of long delays in turnarounds where they have found totally unexpected things which have caused a schedule of two or three weeks to maybe double. The other factor which can cause delays is plant modification. A maintenance turnaround which just deals with maintaining what you've got is one thing but more often than not the turnaround is used as a time to put in substantial modifications, some of which we saw from this morning. It is these additions to plant which have the potential to cause substantial delays, because you are essentially commissioning a new piece of equipment at the start-up and you've made some fundamental design changes to the plant. I think sometimes these things are overlooked in general planning.

Jan Pedersen:

This is a common problem, especially if you have quite a few modifications which I would call project work - installing new equipment or modification of an existing unit. In addition you have the maintenance part - repairs and replacements - and this can create a problem because sometimes these jobs are handled by different organisations. You have a project organisation and you have a turnaround or a maintenance organisation and sometimes they work in parallel rather than working together. This again makes it very important that during the initial planning you combine these two aspects and you see what project work and what maintenance work is scheduled because sometimes it has to be done within the same vessel. We have a number of occasions where we have to carry out some modification at the top of a vessel and at the same time are doing other maintenance work at the bottom and you have to combine these two. That's why it's important that you don't just try and use whatever you have in terms of experience from the last year or the previous turnaround but really sit down and analyse the job as though it was a completely new job you have never done before, because that's the only solution, the only way to get proper planning.

Pan Orphanides, Consultant, Greece:

For these unexpected events I advise plant owners planning a large turnaround to do what we are doing in when you have to carry out a plant Hazop study, by asking the question "What if?". For instance what if the catalyst you expect to be free-flowing to get out actually bridges, what if your tubes get hydrogen embrittlement and you cannot cut them? Thus we plan options for alternative ways to intervene and not lose time to the unexpected. If you are considering this approach in your initial planning it helps to face the unexpected and avoids having to find a last-minute solution and losing both time and money.

Jan Pedersen:

I agree. What we normally try to do when we select contractors is to use contractors which are capable of supplying additional manpower for unexpected jobs. If you suddenly find out during the turnaround that the job has to be extended significantly, and you have employed a contractor who hasn't got spare manpower, you have the problem of trying to get somebody else in. If we suspect there could be some uncertainties we like to be sure that the contractor has the available manpower in case it should be needed. Of course at pre-planning you have to work very closely with the inspection people so that you know the actual condition of the plant. Can you expect anything that could be dangerous or in any case critical for the turnaround? Sometimes you get a concrete answer but not always, unfortunately. You can't know everything, if the plant is on stream you just can't inspect it.

The Chairman thanked the speaker.