Project Title:

Determining the appropriate chemical regime for auxiliary boilers and distillation water evaporators due to the increase in the chemical parameters of their feed water due to the change in the water regime of the Karun River in recent years

Department:	Power plant chemistry upgrade and development plan (water, fuel and oil)	***Employer:***	Niroo Research Institute
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Project Necessity: Ramin power plant is one of the largest steam power plants in the country, which is located at 20 km of the road from Ahvaz to Masjed Soleiman. This power plant has been constructed to supply electricity to Khuzestan province and the national network and has 6 units (4 units of 305 MW and 2 units of 315 MW) with a production capacity of 1850 MW. The first unit was put into operation in 1979 and the last unit in 1999. The fuel of the power plant is natural gas, which is also used in emergency situations. The source of water supply of the power plant is from Karun river and after performing physical and chemical treatment operations, it is used as industrial water, soft water and distilled water. The instructions related to the chemical regime of auxiliary boilers and distillation water operators are related to 22-42 years ago and due to the change of chemical regime of Karun river water and increasing TDS of water, especially its total hardness and chloride over the past decades, The chemical regime of feed water and distilled water and steam produced by auxiliary boilers and evaporators, as well as the conditions of operation and chemical control of this equipment should be reviewed.
Therefore, in this project, the chemical problems of Ramin power plant (focusing on the proper chemical regime of auxiliary boilers, single evaporators and distilled water) are identified and evaluated. For this purpose, it is necessary to list the existing problems around auxiliary boilers and evaporators of Ramin power plant with chemical attitude during face-to-face visits, field and laboratory studies and evaluation of documents. In the following, executive and operational solutions for defects should be suggested for the listed problems. Proposed solutions should be reviewed from the operational point of view and the conditions of the power plant and should be implemented and accepted by the employer. Obviously, solutions with the greatest impact on improving the quality of steam and distilled water, as well as reducing corrosion and sedimentation should be presented. Obviously, solutions with the most effectiveness and the least cost of implementation and the least amount of chemicals and with environmental considerations are acceptable.

Project Goals:

Provide a comprehensive technical and economic report on achieving solutions to improve the chemical status of Ramin power plant, including the following general items:

- Investigate problems and provide solutions to improve water TDS
- Study and provide solutions to modify chemical injections to improve soft water conditions
- The possibility of using membrane technology to improve and modify the chemical regime of feeding water
- Study and provide solutions for injecting chemicals into auxiliary boilers and, if necessary, evaporators
- Review the application of new guidelines and standards
- Evaluating the effect of changing the amount of bleed in the parameters of improving water and steam quality
- Investigation of chemical change of AVT to OT

Abstract:

Water acts as the main fluid in steam power plants as the bed of energy transfer in steam power plants. The issue of energy transfer by water is important from two aspects in heating power plants. One is that in the steam cycle, water takes thermal energy from the fuel used in boilers or other equipment and turns it into steam with high thermal energy, which transfers this energy to the turbine blades. The rotation of the turbine blades with this energy causes the generator to rotate and generate electricity. On the other hand, water in power plants can act as a cooling fluid in converters, cooling towers and condensers, and after absorbing energy from the cycle, it is discharged to another environment. Therefore, the discussion of water quality and consumption in the power plant industry is very important. Due to the high pressure and temperature of steam in various components of the steam turbine as well as the circulating water in the steam cycle system and converters, water quality is very important. The presence of impurities can damage the turbine blade or cause corrosion in various parts of the cycle (converters, drums, tanks and communication pipes). The presence of any type of impurity, including ions, can cause damage to various parts of the cycle or turbine. On the other hand, the presence of particles in the boiler water and steam reduces the life of the turbine and leads to high costs in the power plant. On the other hand, low water quality can lead to poor operation of the plant and increase maintenance costs. Therefore, purification of incoming water and recovery of cycle water consumption is very important.

Water consumption of Ramin power plant is supplied from Karun river. The water quality of the Karun River has declined sharply in recent decades. Climatic problems and reduced rainfall in recent years, along with the release of agricultural and industrial effluents in the Karun River, have caused the chemical parameters of river water, especially TDS, to increase significantly during the last decade. This has caused the Ramin power plant, which uses Karun water in the power generation cycle, to face various problems in recent years. These problems include corrosion and fouling in the auxiliary boiler, its evaporators and single evaporators. In addition, other challenges have been created in the plant's water treatment system. Therefore, the study of the effect of Karun water chemical regime on the chemical performance of Ramin power plant was considered by the officials of that complex. Subsequently, the present project entitled "Determining the appropriate chemical regime of auxiliary boilers and distillation water evaporators due to the increase of chemical parameters of their feed water due to the change of Karun River water regime in recent years" was proposed by the esteemed officials of Ramin power plant and company Dear mother, the specialist in thermal electricity informed Niroo Research Institute.

In the first phase of the project, a general description of the problems of the power plant should be prepared by holding meetings, correspondence, conversations and visits. After summarizing the problems of Ramin power plant, the project team thoroughly investigated them and tried to provide appropriate solutions to each of the problems by holding regular meetings, discussions and related studies. At the end of the first phase of the project, generalities about the problems of Ahvaz Ramin power plant were discussed in the discussion of power plant chemistry. In the next phases of the project (including the second, third and fourth phases) it was tried to carefully study the problems, scientific and technical studies, meetings, consensus of different parts of the project team, correspondence and conversations with technical officials of Ramin power plant. Review.

At the end of the project, by reviewing the scientific content and considering the technical conditions of the power plant, the following solutions of the employer and the power plant were presented:

1- Lack of sedimentation basin (Setling Basin) at the place of water withdrawal from Karun river and the urgent need to build a sedimentation basin with appropriate equipment is perfect and acceptable.
2- Increasing the performance of sedimentation pools in removing water turbidity by using ferric chloride as coagulant and polyacrylamide as coagulant and sodium hydroxide to increase pH and achieve maximum sedimentation and maximum removal of suspended solids and hardeners Water turbidity.
3- Removal of silica (SiO_2) using $Ca(OH)_2$ calcium hydroxide and MgO magnesium oxide at temperatures between 35 and 60 ° C in the main clarifiers of the power plant next to the treatment plant.
4- Due to the impossibility of achieving the standard molar ratio of sodium to phosphate in the chemical control of start boilers using trisodium phosphate, due to the continuous production of sodium ions during the operation of sodium cation converters in water softening, so no Not only precise chemical control is not possible, but also sodium ions produced by sodium cationic columns cause CLNA formation and corrosion in starter boilers continues continuously. However, in order to improve the system, it is suggested that instead of the chemical control at the pH between 8 and 9.5, which is currently being done, the pH control range be slightly increased and controlled between 9.5 and 10, and the amount of alkalinity between Maintain 200 to 600 ppm.
To remove oxygen, which is a very corrosive and destructive element in causing corrosion in start boilers, the use of diethyl hydroxylamine (DEHA) as a deoxygenating agent and a suitable alternative to hydrazine has been suggested. Of course, other amines such as octacyl amine, cyclohexylamine, morphine and tannins can also be used. The use of sodium sulfite, despite its cheapness and availability, is not recommended because it does not passively pass the metal surface to withstand the onslaught of corrosive ions.
6- According to the investigations and considering the relevant interests, it is possible to change the chemical control regime of the main boilers of Ahvaz Ramin power plant from AVT to CWT. The conversion steps are explained step by step in this report.
7- Proposing the use of a reverse osmosis (RO) treatment system with a mixed bed column (Mixed Bed) in the water treatment system of Ramin power plant, which can solve a significant part of the water treatment problems and corrosion of the power plant.
8- Using resin and ion exchanger columns only to purify the feed water of the units by installing two rows of ion exchanger columns including hydrogen cation column, degasser, anion column and Mixed Bed column in a symmetrical flow (Counter Flow).
9- In order to prevent the spread of salt powder on the power plant equipment, which is converted into highly corrosive salt water on the surface of the power plant with the moisture obtained from wet towers and condensed vapors, causing corrosion of all open equipment in the power plant. Necessary action can be taken to roof the salt depots in both power plants. This issue was stated in the first phase report and due to the specificity of the proposal, its details were not mentioned in the report of this phase.
10- Regarding the discussion of TDS and its increase in Karun River in recent years, the use of reverse osmosis method along with equipping the treatment plant with anionic resin is suggested. This can significantly reduce the amount of input TDS and reduce corrosion of power plant equipment in the coming years. If it is not possible to install anionic resin, the construction of RO unit alone will play a significant role in reducing the TDS of water entering the plant.

Steps and Methodologies:

- Collection of documents (including technical documents and general defects of the power plant).
- Sampling and analysis and TDS of Karun river water, application of new water treatment technologies, new guidelines and standards and the effect of changing the flow.
- Sampling and analysis and review of chemical injection modification, determination and change of chemical control regime.
- Summarizing and prioritizing solutions.

Main Results (technical outputs, patents, papers, books, reports, etc.):

Final report.