

## Company information

### Air Liquide in the world

The world leader in gases, technologies and services for Industry and Health, Air Liquide is present in 80 countries with approximately 68,000 employees and serves more than 3 million customers and patients\*. Oxygen, nitrogen and hydrogen are essential small molecules for life, matter and energy. They embody Air Liquide's scientific territory and have been at the core of the company's activities since its creation in 1902.

Air Liquide's ambition is to lead its industry, deliver long-term performance and contribute to sustainability. The company's customer-centric transformation strategy aims at profitable growth over the long term. It relies on operational excellence, selective investments, open innovation and a network organization implemented by the Group worldwide. Through the commitment and inventiveness of its people, Air Liquide leverages energy and environment transition, changes in healthcare and digitization, and delivers greater value to all its stakeholders.

Air Liquide's revenues amounted to €16.4 billion in 2015, and its solutions that protect life and the environment represented more than 40% of sales. On 23 May 2016, Air Liquide completed its acquisition of Airgas, which had revenues amounting to \$5.3 billion (around €4.8 billion) for the fiscal year ending 31 March 2016.

Air Liquide is listed on the Paris Euronext stock exchange (compartment A) and belongs to the CAC 40 and Dow Jones Euro Stoxx 50 indexes.

### Air Liquide (AL) in Russia

Air Liquide was established in Russia in 1989 and was primarily concerned with the sale of industrial gas production equipment. In 2005, OOO Air Liquide, the Russian subsidiary for production and sale of industrial gases was founded. Today, the company operates 15 industrial sites in key regions. More than 600 employees supply products and services to over 1,500 Russian and international customers. Air Liquide has already committed to investing more than €450 million in Russia.

## Case specification

For each AL plant the most critical parameter is the reliability and continuity of the operation of the equipment. For this purpose, AL focuses on preventive control measures and correct operation of the equipment in strict compliance with the technical regulations.

As a rule, every three years, AL makes scheduled stop of the equipment for maintenance work. Planned stops of AL's equipment occurs during planned stops customer's equipment. AL may proceed with the planned maintenance of the equipment only when the customer's equipment stops and only after the complete stop of the AL equipment. The priority for AL is to complete maintenance, test, start-up of the equipment and to start the production of gases up to date and planned time of planned start-up of the equipment of the Customer. All of these actions are required in order to prevent the Customer downtime and avoid financial and reputational risks of the company AL.

### Specified condition:

AL production site is located on the territory of the Customer in Nizhny Novgorod city and produce industrial gases only for Customer consumption.

Currently, there are the following employees available in AL production plant to be involved in maintenance work:

- plant manager - 1 employee;
- production manager - 1 employee;
- maintenance manager - 1 employee;
- mechanical engineer - 2 employees;
- instrumentation engineer - 2 employees;
- electrical engineer - 2 employees;
- HSE engineer - 1 employee.

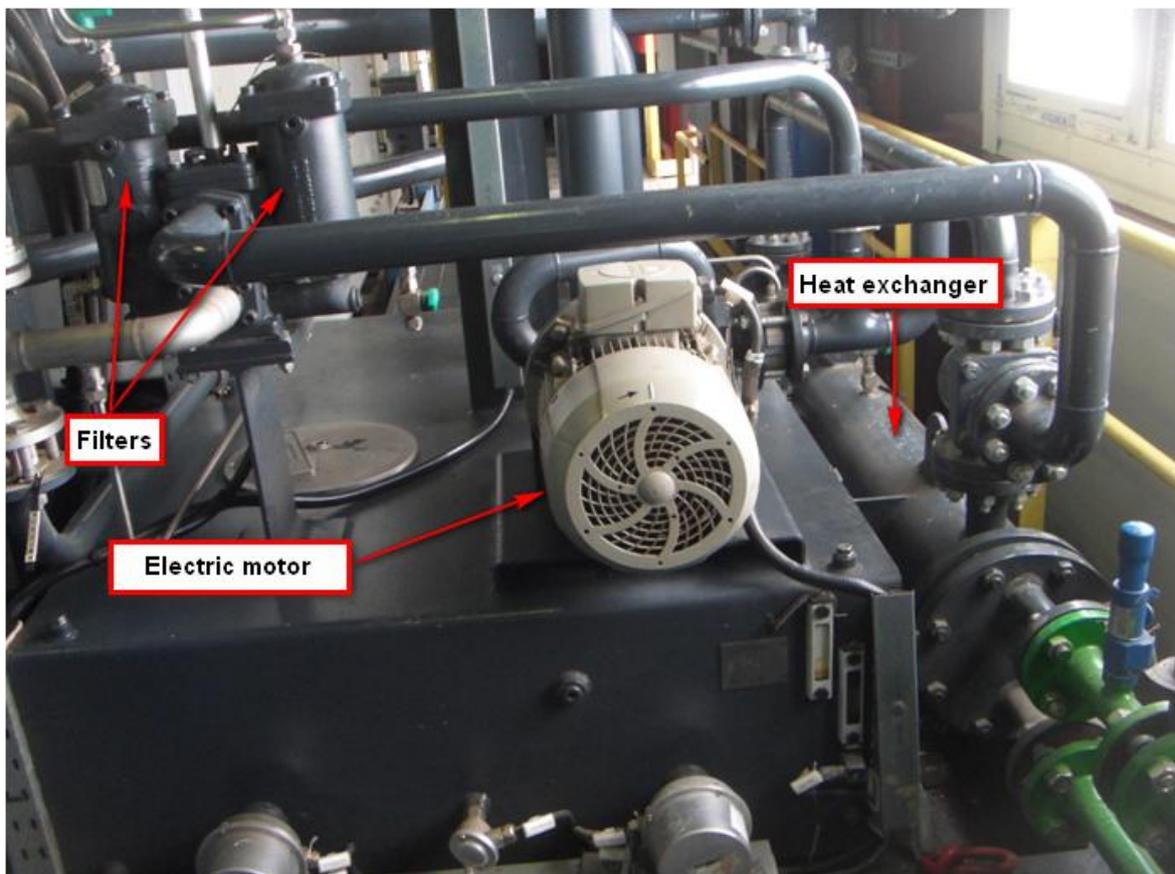
If needed it is possible to involve to maintenance work some staff of subcontractors, in case AL has service contracts with these external companies for repair and maintenance works.

The Customer plans to stop consumption of product from 23:00 30.09.2017 to 23:00 01.10.2017. To stop AL plant and prepare equipment for maintenance is required 1,5 hour. For pre-starting test and restart of AL equipment after stop is required not less than 3 hours.

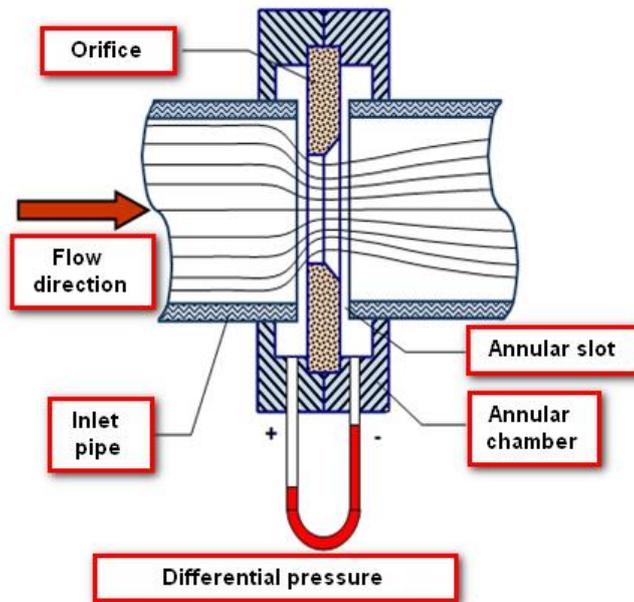
**Here is a list of planned maintenance activities during the stop of AL equipment:**

- Planned maintenance of Oil system on Expansion Turbine (ET) which is included: inspection of heat-exchanger (water side); tightening of threaded connections; oil pump electrical motor replacement\*;

\* - delivery period of the motor is 35 weeks



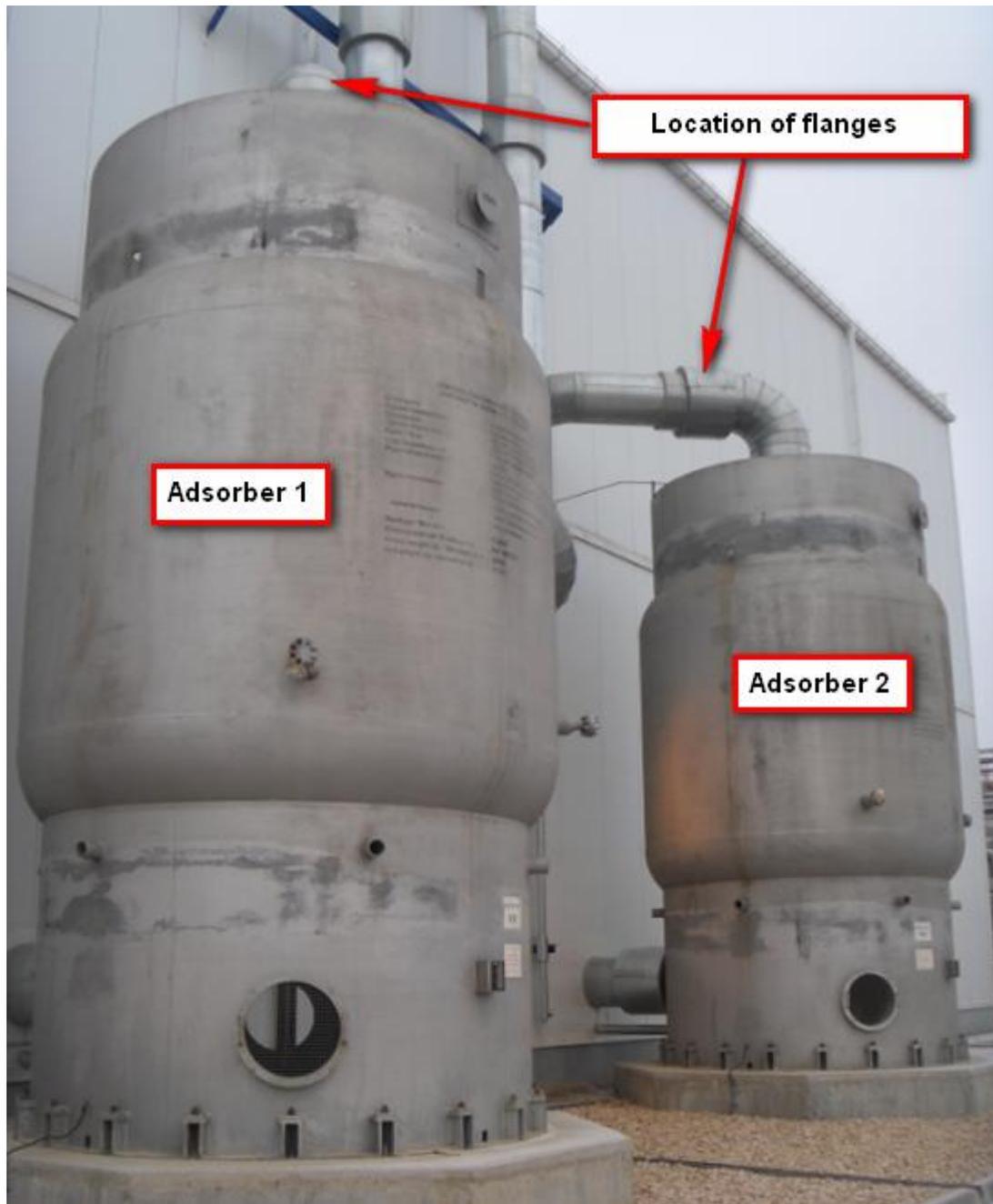
- State verification of orifice flowmeters (3 pcs.) which are installed on 8" pipes in Standardization and Metrology Center.



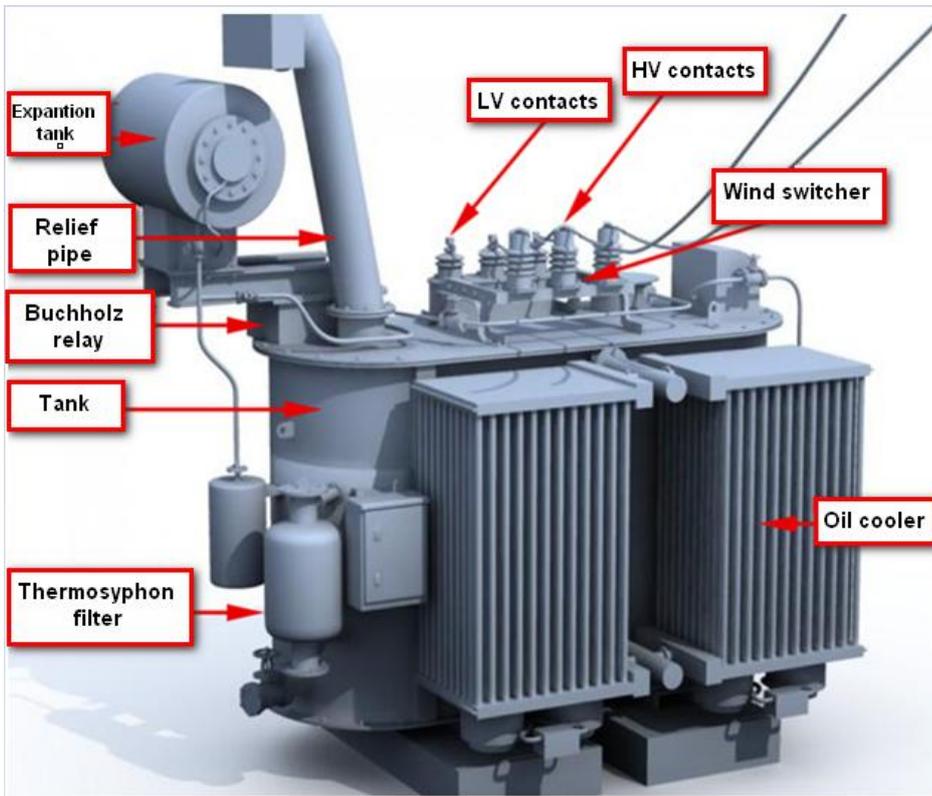
- Test of Pressure Safety Valves (PSV) size 1/2" - 20 pcs.; 10" - 3 pcs.; 14" - 8 pcs; it is important to prepare all needed tools and etc. for the test;



- Replacement of two flanges on Adsorbers. The flanges are located at a height of 6 meters. Pipelines diameter is 800 mm, process pressure is 20 bar. It is important to identify methodology of quality control for two new welding seams;



- Planned maintenance of Transformers. It is possible to do during complete stop of power supply for 4 hours. During a power stop you have to use a backup diesel generator, which is constantly place on the production site.



- Planned maintenance of DCS - Distributed control system - testing and backup\*\*. Duration of maintenance - 10 hours.

\*\* - For 6 month in advance need to organize preliminary visit of specialists for inspection during process.

**The task:**

You are members of AL maintenance team, who are incharge of planning of all maintenance work on AL plants. You have the following tasks:

1. To carry out the preparations for all maintenance work of equipment on production plant based on predetermined conditions described above.

1.1. To develop a detailed schedule of maintenance work for the production plant, based on the need to implement the above scope of work in frame of given conditions.

1.2. To identify the necessary human resources (number of specialists (external (third-party employees), internal (employees of AL), work schedule, the costs of outside staff) for each type of work. To optimize human resources by selection of a rational number of specialists for each type of works.

2. Based on the experience which you obtain after performing task No 1. you need to perform the following tasks:

- 2.1. To develop standard schedule of preparation for maintenance work which will be used for preparing maintenance work for all AL production plants in Russia.
- 2.2. To develop a universal tool of control of preparation for maintenance work progress.
- 2.3. To consider the full cycle of the order and delivery of the necessary for maintenance work imported equipment (obtaining the necessary permits and certificates for the equipment in accordance with the Russian legislation requirements; transport and the optimal delivery scheme (in accordance with INCOTERMS 2010); minimization of risks for the delivery on time).
- 2.4. To develop criteria for checking subcontractors during the period of selection suppliers of goods / services, subcontractors to perform certain types of work.

#### **Additional information**

If, from your point of you, the specified conditions of the case don't contain enough information, specific data, you are free to add required information to the specified conditions of this case.

**Thank you very much for your participation in the solution of this case and for your courageous and innovative ideas!**