# GEODETIC MEASUREMENTS OF PIPELINES DISPLACEMENT IN CHP POWER STATIONS

**Dorota Latos, Marek Pałys**
**Warsaw University of Technology**

**Krzysztof Baszkiewicz**
**Military University of Technology**

## 1. INTRODUCTION

**This document is on the subject of measurements of pipelines displacement of fresh, secondarily overheated steam and secondary overheating in "Siekierki" CHP power station.**
**Analyzing particular types of pipelines one should pay attention to the fact that in the process of making geodetic measurements these different pipeline types doesn't matter. It's always that an object of the measurement are characteristic points of pipelines, consulted with the employer, which portraying changes of the location of pipelines under the influence of changes of the temperature in the best way. The size and direction of changes of the location of characteristic points of the pipeline constitute the valuable information for the assessment of exploitation conditions of the pipeline as well as it lets predict possibility of the breakdown of the analyzed fragment of the pipeline with the great probability.**

**Fig. 1. Geodetic measurements in CHP power station.**

**Measurements of pipelines in CHP power stations belong to the group of specialist measurements. They aren't carried out by geodesists in every day routine. This fact results from the specificity of the object and from the amount of objects of this type in the country.**

## 2. CHARACTERISTIC OF AN OBJECT

**As an objects of the measurements were pipelines located at the power unit No. 8 at "Siekierki" CHP power station in Warsaw.**

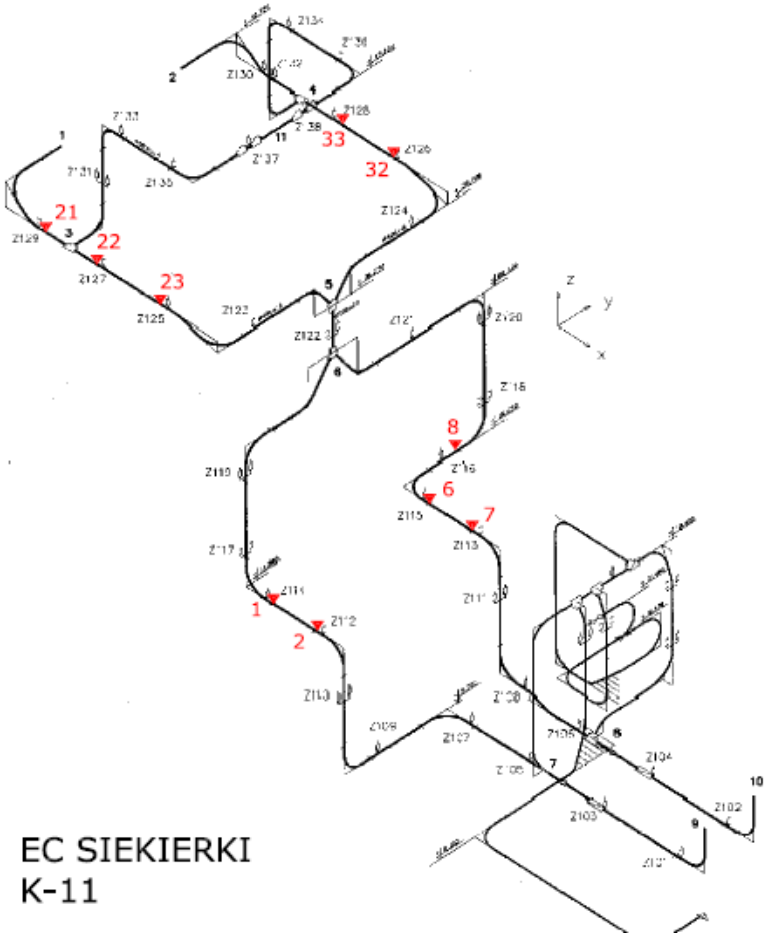


**Fig. 2. Scheme of pipeline 1.**

**The pipeline of fresh steam on the level of outlet chambers of the last stage of the primary steam is a symmetrical two-line pipeline. From a type „Y" joint all the way to the turbine it is a one-line complex geometry pipeline.**
**The pipeline of secondarily overheated steam has very complicated spatial structure. The upper two-line segment is symmetrical regarding to the boiler. From the bottom type „Y" joint to the turbine the pipeline is two-line and asymmetrical.**

**Steam pipeline for the secondary overheating is a two-line pipeline, asymmetrical to the boiler axis.**

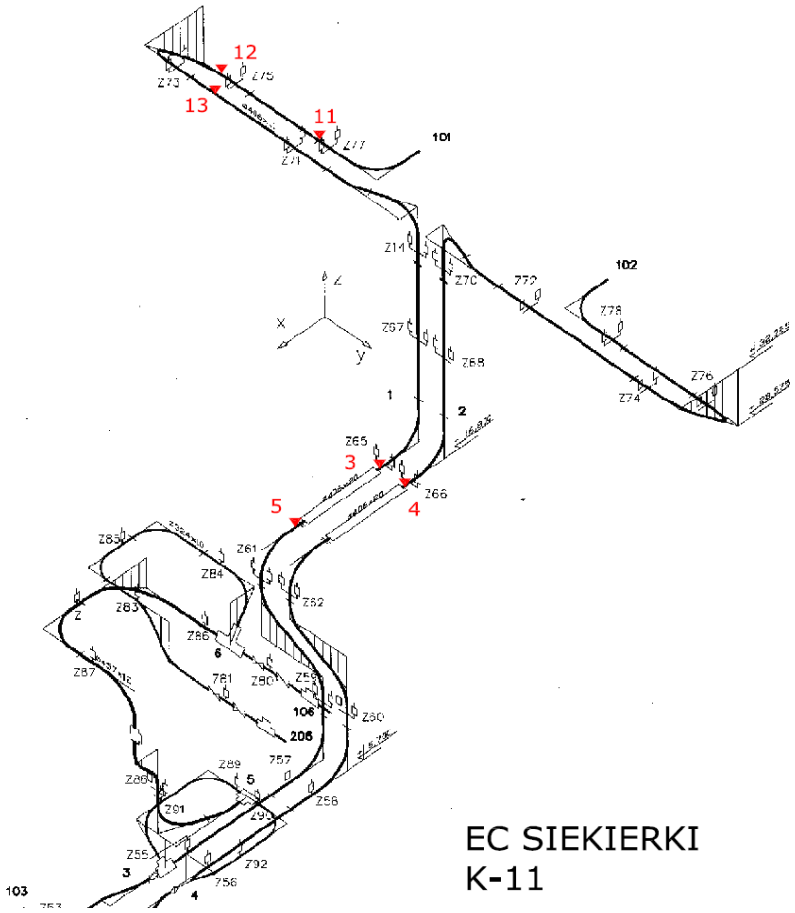


**Fig. 3. Scheme of pipeline 2.**

## 3. MEASUREMENT CONDITIONS

**Measurements were conducted in the changeable temperature in the scope from 30° C up to 70° C, in conditions of big dusting and the blackout and with stoves of CHP power station under fully operated. The work of boilers was causing a vibration of surroundings, especially of landings, which were only possible sites for the measuring instrument. In certain cases fastening the instrument to the construction of the hall (poles) is possible, nevertheless it isn't reducing the vibration caused by working boilers in any significant amount.**

## 4. MEASURING WARP

**The hall of boilers of the CHP power station doesn't give a possibility to establish survey control stations in the way well-known for a „classical" geodesy. Local conditions, particularly the limited space, are forcing some limitations in the approach to the problem of survey control.**

**Fig. 4. Survey control point.**

**Due to difficult measuring conditions the "Siekierki" CHP power station survey control was established in the local reference frame, orientated to the arrangement of load-bearing poles of the hall.**
**The change of the location of any pole among particular measuring cycles doesn't influence the result of the measurement of pipelines displacement in significant way. Measurement points were established at load-bearing poles in such way that it was possible to mount on them a maneuverable mirrors. Survey control was measured in such way that as a result of survey control adjustment every point of it had coordinates in a chosen local reference frame. The received accuracy of control points didn't exceed 3 mm. Points of survey control were established in possibly stable and not exposed to damage places. The measurement of survey control points was carried out with electronic tachymeter with the prisms. Measurements were carried out with the TOPCON GPT- 3107N instrument. Measurements were carried out using polar method, in the reference to the largest possible number of control points.**

**Fig. 5. Measurement point.**


**Fig. 6. Measurement point.**

**They were made in 3 measuring series due to attempt to eliminate the instability of instrument site base. Since the location of control points was determined in the XYZ reference frame, making the reference to the control points was giving a spatial orientation to the instrument and it let for receiving coordinates of the measurements also in the XYZ frame.**

**Table 1. Coordinates of measurement points.**

| No. | X | Y | Z |
|---|---|---|---|
| 1 | 93.084 | 108.926 | 102,172 |
| 2 | 89.519 | 108.792 | 102,188 |
| 3 | 93.254 | 116.591 | 101,804 |

**16 measurement points were stabilized at analyzed pipelines, all at places of best reflecting the shape the pipeline.**

**As a result of evaluating measurements, the XYZ coordinates of measurement points were get, which next were projected on the pipeline axes.**
**One should underline, that measurement points putted directly on the hot pipeline, which were additionally several dozen meters above the level of the floor of the hall, they aren't particularly simple and safe place for conducting measurements (e.g. putting maneuverable mirrors on them).**
**Assessment of expected sizes of displacement (an order of a few cm) and arrangements with the client allowed for using less accurate methods (e.g. a range-finder without mirrors). With relatively short aim lines of an order of a dozen or so meters it gives precise measurement of direction with smaller distance accuracy level. An average error of received coordinates was ± 5 mm.**

## 5. SUMMARY AND CONCLUSIONS

**Analyzing results and conditions in which measurements were conducted one should state that it is essential to locate measurement points at pipelines in a right way, which will allow for making observation of the same points from different positions of the instrument.**
**The measurement points should be assembled during the assembly of the pipeline.**

**The polar method with using the tachymeter without mirrors is a fastest and most reliable method of the measurement.**
**In such difficult measuring conditions one should conduct measurements in a few series. Observation carried out will be compared with similar measurements made in the cold state and in the hot state after the exchange of pipeline "knees", molders and after checking the quality of joints of the pipeline.**

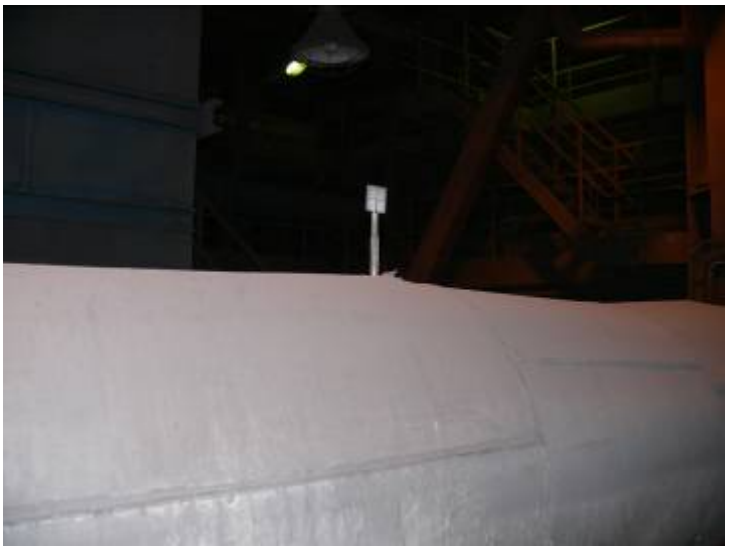

**Fig. 6. Measurement point.**

## REFERENCES

**Baszkiewicz K., Latos D. „Technical report regarding pipeline measurements", Warsaw, 2008.**