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TEST RUNS AND TAKE-OVER CERTIFICATES OF SUGAR PRODUCTION PLANTS 1/

by

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SUMMARY

Test runs should be specified for large or small installation items.

Nine items are check listed for use in writing specifications for test runs.

Arbitration may or may not be necessary but its potential need should be recognised.

A detailed outline of specific requirements for three exmaples of testing requirements for a new installation before take-over acceptability is indicated. These refer to a new steam generator installation, a process change in juice clarification and an installation of automatic instrumentation for a set of evaporators.

Writing of take-over certificates are discussed and special attention drawn to likely national requirements for safety, qualification of operators and environmental influences.

The need for good vendor-customer relationships at all times is emphasised. A contract should terminate with good relations being maintained between the two parties.

A. Introduction

The organisiation of test runs and take-over certificates starts before the contract is drawn up in the first place. During the period in which specifications are being prepared it is necessary then to consider how these specifications can be met and the manner in which test runs will be carried out. In what respect will the installation prove itself satisfactory to the purchaser and how can the vendor be satisfied that he has left a satisfied customer.

Test runs and take-over certificates are just as important to the vendor as they are to the purchaser. They are in fact references which he can use for furthering the sales of his products elsewhere. As in all trading transactions it is always important for the vendor to meet the wishes of the customer as far as possible and at least to leave a satisfied customer.

Inevitably there will be occassions when satisfaction is difficult to achieve and some form of arbitration is necessary and which needs to be provided by an independent but nevertheless effectively qualified party. Sugar associations can very often act in this capacity.

B. Test Runs

The first question which arises is "what is a test run?" The type of equipment or process will to a certain extent determine the nature of the answer. The following features may be considered common to most situations:

1. Capacity
2. Reliability
3. Efficiency
4. Service life
5. Overload behaviour
6. Safety
7. Environmental acceptability
8. Period for test runs

9. Modulating conditions

The units which are used to define the operations of the situation under test are just as important as defining the nature of the tests themselves.

Test runs of a highly specialised character would generally apply only to installations of substantial magnitude or major process changes. However even the smallest installation should be associated with a satisfied customer - vendor relationship.

Instrumentation offers possibly a more difficult area for defining satisfaction to the customer than may be the case for large and distinct pieces of equipment.

Perhaps the best way to further consideration of test-run features is to give some examples, three of which will be considered in some specific detail.

Those selected will be:

(a) A new steam generator installation
(b) A process change in juice clarification
(c) An installation of automatic control instrumentation for a set of evaporators.

C. Test-Run for a Steam Generator Installation

Let us assume that a new steam generator has been installed in a sugar factory for which the contract agreement specified certain capacity and over-load ratings.

Before carrying out a test-run it would be expected that the operation of the equipment would initially be under the control of the vendor until such time as sugar factory personnel have been trained and management has given at least verbal indication of satisfaction.

The extent to which training of personnel is to be carried out should

be part of the original agreement. This might include transfer of personnel for a specified training period to some other plant where the installation has been made. On the other hand it might be considered satis factory for both parties for the training to be on-site under the supervision of representatives of the vendor.

The conditions under which the test run needs to be carried out must be agreed upon. In this case there will probably be three normal conditions to be satisfied:-

(i) start-up
(ii) normal operation at average rating
(iii) shut-down

Start-up and shut-down conditions are more important where these occur with higher frequency. The period between maintenance breaks in operation may vary from 5 or 6 days to a month.

In the case of a cane mill the start-up and shut-down periods will be associated with a cessation of a substantial proportion of demand for steam for prime movers whilst steam for evaporators, pans and some portion of the electric power generation will continue.

The extent to which these factors influence the operation of the new steam generator will need to be identified. Where the steam generator supplies only portion of the load, conditions may differ from those in which the new steam generator is to provide for the entire load as is the case with some of the most modern installations.

The first item then to measure is the capacity of the unit. Normally it will be rated in tonnes of steam per hour or some other mutually agreed units. The next problem is to measure the capacity. How reliable are steam flow meters?

The author has observed some installations of new steam generators in a developing country which have not even been equipped with a flow meter. Capacity satisfaction was measured in terms of steam pressure under normal load. This is not really a satisfactory technique

of measurement, nor is operation particularly satisfactory without a flow meter.

Calibrating a steam flow meter is not easily performed directly. The only satisfactory absolute check is to weigh the feed water over a period of time. This is generally very inconvenient and seldom carried out in practice. The next best is a positive displacement feed water flow meter which has itself been weight calibrated, preferably in-situ.

When steam loads are fluctuating it is very difficult to maintain satisfactory precision of a flow meter over a wide range of fluctuations. It will be necessary to agree upon accepting capacity measurements under constant load conditions for agreed time periods and to make every endeavour to arrange for constant load over the time period specified with adequate margin at each end.

This is more easily achieved where a steam generator is only one unit among several than when it is the sole unit.

Reliability is a criterion difficult to define in specific terms but easily recognised in real life. Objectively it may perhaps be best defined as ability to maintain specified operating conditions with a specified minimum of lost time or ineffectiveness. There would not be open-ended specifications but would have some time period specified.

Efficiency of a steam generator is normally defined in terms of the percentage ratio of heat in steam delivered to the heat in the fuel supplied. Whether B_h or B_l be used to specify the calorific value of the fuel is largely immaterial as far as the test run period is concerned provided there has been prior agreement.

There will probably be quality specifications with respect to the fuel. In the case of bagasse this will include moisture specifications which have a very important bearing on the burning characteristics. If the moisture is too high the bagasse may not burn at all. If it is too low it may flash burn generating undesirably high temperatures in the

furnace.

Obtaining a satisfactory measure of the weight of bagasse during the test period(s) is difficult. It may be necessary to commission a group of operators to manually weigh the bagasse during the test run. This is about the only way in which the measurement can be made for a single generator in a group. For a mono-unit generator it is necessary to accept the crushing rate and fibre in cane analysis and then to manually weigh surplus which is generated or make-up which is extracted from the stock-pile during the test run.

Associated measurements should include flue gas analysis, furnace and other temperatures, draught gauge readings, steam and feed water temperatures and pressures and other information which might be considered relevant to the efficiency of operation.

One of the first things to do is to check the accuracy of the instruments to be used. Flue gas analysis which gives a good indirect check on efficiency by allowing calculation of the major heat loss is not as straight forward as the dials of modern instruments might lead us to believe.

Most such instruments are satisfactied with the measurement of the CO_2 concentration employing the principle of gas thermal conductivity. This is reasonably satisfactory for oil or coal field boilers as would be experienced in a refinery or in the beet industry. Bagasse fired boilers however do not give reliable results with meters depending upon thermal conductivity. The reason for this is that flue gases from incomplete combustion conditions can carry hydrogen and hydrocarbons which render such measurements inaccurate. The only satisfactory technique for such conditions is an instrument operated on the Orsat gas analysis principle. These can also give a positive measure of the concentration of unburned gas which is important for understanding the behaviour of the furnace.

For any test-run condition personal Orsat units for spot test analyses are satisfactory and commonly employed. They are however

manufactured to different standards of precision. For good work a mercury Orsat rather than a water Orsat should be used. The best equipment of this types also allows differentiation of the unburnt gases between CO, H_2 and unsaturated hydrocarbons. All this information is of value for the analysis of test run behaviour.

Expert care is necessary in the use of pyrometers for temperature measurement. Not only should they be checked for accuracy of information but their siting within furnaces, flues or ductwork requires expert attention to avoid erroneous information.

Draught gauges themselves usually read out with satisfactory accuracy but their siting should be carefully and expertly checked for the test-run in order to make sure that the information does represent the conditions it is desired to measure.

Service life is not really possible to measure on a test run but where this may be the subject of some type of quarantee the condition of the equipment and the conditions of operation should be carefully checked on the test run. These include such items as refractory bricks and other surfaces, water tubes, water and steam drums, heat exchanger surfaces, grates, stokers, fans and other auxiliary equipment. The workmanship associated with the installation should be checked at all points.

In contracts for steam generators there is usually some reference to their ability to operate at higher than normal rating for short periods of say 2 hours at a time. The ability should be the subject of test-runs specifically designed to test whether the unit is able to meet this particular item in the specifications.

It is necessary to bear in mind that whilst the unit may readily meet the over-load specifications these specifications should not be exceeded during normal operation, otherwise many of the conditions of warranty relating to service life may be invalidated.

Steam generators must be checked for safety of operation by specially qualified inspectors who have appropriate experience in the operation of

high pressure equipment of such a character. These safety measures and inspection are usually under the surveillance of nationally appointed inspectors of recognised capability. There will be regulations and acts of parliament with which complaince must be achieved.

Both customer and vendor are in the hands of the official inspector as far as thses points are concerned.

Operators of steam generators also need to be appropriately qualified and the qualifications required for being in charge of or operating high pressure steam generators is usually set down by national authority. The responsibility of ensuring that operators do comply with such qualification requirements will ultimately rest with the customer, but it may well be written into the agreement that the vendor should train the operators to a standard appropriate to the regulating requirements.

The effect on environmental conditions of operating the steam generator may well come under the control of some national or locally appointed authority. In any case the sugar factory management should be of sufficient civic consciousness to ensure that the environment is not polluted as a result of the installation.

Pollution may arise from anyone or more of a number of different sources. Perhaps the most conspicuous and most common is the gas coming out of the chimney stack. Bagasse fired furnaces are usually the worst offenders with coal fired units less so but probably worse than oil fired units.

General dust pollution may arise from wind blown dust carried from the bagasse storage heap or from a heap of ashes, possibly also from coal especially when unloading trucks or during on-site transportation.

Thermal pollution of the immediate service environment can result from inadequate or incomplete insulation. This can also be considered from the point of view of safety requirements for the protection of operating personell or visitors.

Liquid effluent in the form of water circulating for special cooling purposes will require disposal as warm or hot water and its effect on the environment at the point of disposal must be checked. Other waste water may carry ashes and satisfactory disposal arrangements organised.

Noise pollution has seldom been considered especially in relation to the operation of steam generators. With a greater consciousness developing of the effects of undesired noise arising from the operation of these units will call for a higher degree of attention being paid.

The noise may be from fans, stokers, grates pumps or other moving machinery. Perhaps the most objectionable noise arises from steam being blown to atmosphere at times of emergency pressure release. Avoidance may not always be possible, but the provision of sound muffling equipment is technically feasible even if management seldom desires to incur the expense involved.

Persons are being appointed by national bodies to take cognisance of such matters of environmental pollution and both customer and vendor may be in the hands of pollution control inspectors just as much as they are in the hands of safety inspectors.

The period over which a test-run is to be operated, the time at which it is to be operated and the number of repititions are matters which should be recorded in the contract agreement before the installation is undertaken.

The term modulating conditions is used to refer to conditions beyond the control of vendor or customer or beyond their reasonable control. These are often very difficult to define or anticipate. The vendor probably prefers a blanket escape-clause written in fine print which he hopes will evade the scrutiny of the customer. Whilst the customer needs to be vigilant to protect his own interests, he should avoid modification of conditions which might be to the disadvantage of the vendor but to his own advantage. A great deal of good-will is usually

necessary in connection with such matters and as a last resort arbitration may be invoked.

It can be seen therefore that test-runs for a new steam generator installation are very serious affairs requiring a high standard of technological skill and understanding as well as wisdom and forebearance in implementation.

D. Test Runs for a Process Change in Juice Clarification

A process change in juice clarification is usually an in-service arrangement. Nevertheless management will desire to know whether the cost of such arrangement has been justified by the improvement in results obtained.

All nine items listed under general conditions for test-run operation apply just as much to a change of this type as to the new unit installation just described.

Improved operation may be measured in terms of any one or all of the points recorded except No.8 which refers simply to the period of test runs.

It may not be necessary to proceed step by step through items 1 to 7 and No.9, but this can be decided by the management.

Perhaps the most important and most difficult aspect of an assignment of this particular character is to define acceptable criteria for measurement.

Before implementing plans for such a change in operation and in fact during the planning stage special attention should be given to the manner in which the test-runs should be carried out, the criteria of measurement and the consequent evaluation of data.

The agreement is usually between the management and executive control design staff and the possibility of arbitration being required is generally not even considered. The relationship is that of

employer-employee rather than that of customer-vendor. The employer nevertheless is "always right" and should be considered in much the same light as a customer who should be satisfied.

E. Test-Run for Automatic Instrumentation of an Evaporator Set

It is not unusual for existing evaporator sets to be subjected to automatic instrumental control. Such an installation is complex and of sufficient cost and importance to general operation to justify the requirement of a test-run under suitably supervised conditions before final acceptance.

In this case the relationship will usually be that of customer-vendor and the general conditions relating to such a relationship will apply.

When considering the installation in the planning stage the requirements for a test-run should be thought out and itemised. The nine general conditions will apply in this case with some qualifications. When we speak of efficiency do we refer to the efficiency of the instrumentation as such or to the efficiency of the set of evaporators? The same comment may be applied to others of the test qualification. In fact both are of concern, but the area of responsibility of the vendor of the instruments should be clearly defined beforehand.

If the vendor claims that the capacity of the evaporators will be increased by 10% as the result of the installation of his instrument then the validity or otherwise of this claim should be the subject of specific test.

On the other hand the capacity of the instruments to handle the evaporators should be clearly a responsibility of the vendor under almost any circumstances.

Criteria for measurement of each qualification also need to be agreed upon when the contract of sale is being prepared. Where these relate to service conditions of operation of the evaporators the instrument vendor may not have sufficient specialised experience to

cope with these aspects and some assistance may become necessary.

The customer also needs to be conscientious in the provisions of his side of the agreement. For example the contract may require the customer to provide a supply of clean compressed air as a service for the operation of the instruments. A sugar factory engineer's idea of clean air and reliability of supply may not match with the ideas in the mind of the instrument vendor. Scuh difficulties can be anticipated by the instrument vendor as the result of experience in this field but every instrument vendor usually gains his experience at the expense of the customer.

Good-will and understanding should never be absent from test-run operations, on the other hand careful preparation beforehand can go a long way towards avoiding unfortunate misunderstandings.

F. Take-Over Certificates

These certificates may be considered under two general categories.

There are the certificates issued by nationally appointed boards of vigilance and without which it would be illegal to operate the equipment. An example of these is the safety certificate for the steam generator issued by the nationally appointed inspector whose duty specifically relates to this point.

Management of a sugar factory needs to understand the legal requirements in these areas.

Within this category might also be considered the certificates of competence required by operators before being permitted to operate complex equipment. Again these are usually specified and issued by national authorities responsible for assessing the standards of qualification of personnel.

These certificates should be on display just as much as the certificates of safety. Such display is unusual, it being left to the responsibility of management to check qualifications of personnel either

at the time of appointment or promotion. It may not be necessary to display original documents but at least photo-copies should be made available for this purpose. At the very least they should be conveniently filed in the office of the management for inspection by appropriate authority on relevant occasions. They should be the subject of inspection with regularity comparable with that of equipment inspection.

Then there are the certificates of acceptance, which are generally in the form of a letter, issued by the customer to the vendor after the satisfactory conclusion of the test runs. At this stage payment for services should be completed. It is not necessary that all monies should be withheld until this stage, in fact it is common practice with large installations for progress payments to be made at agreed stages of installation.

This calls for inspection and possibly stage or interim testing before each progress payment is made.

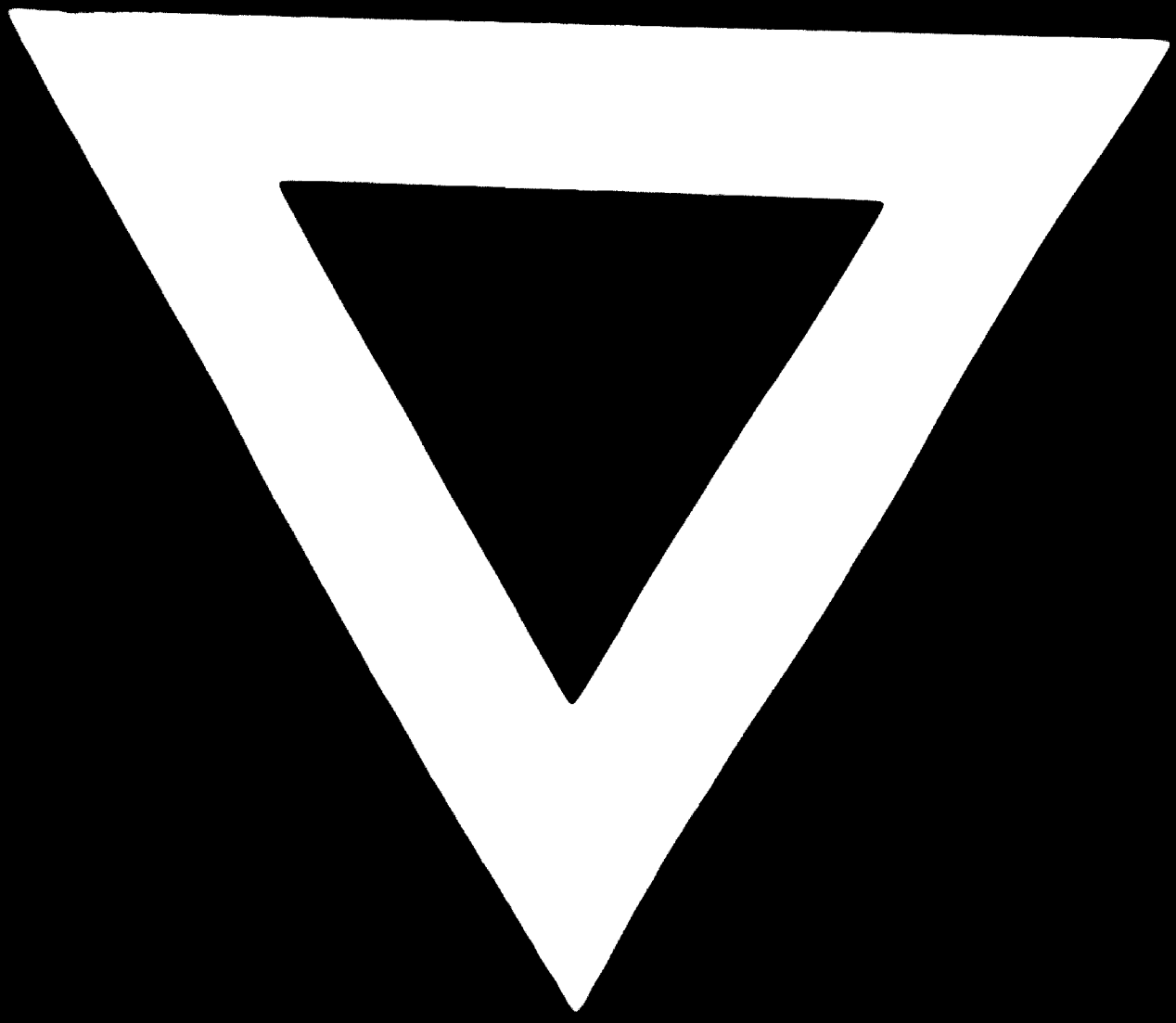
For smaller installations such as the evaporator instrumentation it may be sufficient for a deposit to be paid on placement of the order and the balance on acceptance with possibly one or two intermediate steps depending upon the size of the installation.

It is within the best interests of the customer usually to make such progress payments, otherwise the vendor must operate on credit which incurs interest payment. On the other hand the customer does not begin to earn money on the new installation until it is completed and operating to satisfaction. A mutually agreed progress payment system is the best means of meeting both requirements.

Certificates of acceptance may have insurance and/or maintenance clauses which continue the specific interests of the customer and vendor. These need to be carefully thought-out and worded,and again a substantial amount of good-will may be involved. The best guarantee of a continuing customer-vendor relationship is a satisfied customer.

Questions:

1. In what way should test run programmes be prepared?
2. How best should good customer-vendor relationships be maintained?
3. In what way can an inadequately informed customer protect himself against a difficult vendor?



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