SUDBURY
INTEGRATED NICKEL
OPERATIONS
A GLENCORE COMPANY

Emission Control Procedures

The Central Control Room (CCR) Supervisor at the Sudbury Integrated Nickel Operations (INO) Smelter is required to make decisions on the extent and timing if control action required to ensure that the hourly average ground level concentrations of Sulphur dioxide do not exceed the control limit of 0.34 ppm at the monitoring stations or within the population centres surrounding the Smelter. (Note: the limit will be lowered to 0.25 ppm January 1st, 2016) In addition, fugitive emissions from the plant must not exceed 0.30 ppm, on a half-hour average. This additional requirement affects only the Edison and Parkinson monitoring stations.

The supervisor uses a very sophisticated computer model, along with meteorological forecast information and real-time data to plan Smelter activities and control SO2 emissions. The main control option used for Sulphur dioxide emissions from the Smelter stack is the amount of time converters are blowing. The CCR Supervisor must decide how much impact the Sulphur dioxide emissions are likely to have at ground level and determine the operating schedule for the converter blows accordingly. For the fugitive half hour limit, the main control available is to stop casting and any transfer operations which can lead to fugitive SO2 emissions. When meteorological conditions are especially unfavourable, the furnace can also be shut down to reduce emissions.

As outlined in the Operations Manual, the CCR Supervisor has a number of sources of information to assist with him/her with decision-making, including:

- Real-time and modelled 1minute and 5 minute average SO2 and wind data from the monitoring network.
- Modeled plume display based on real-time SO2 data from network stations
- Running ½ hour and hourly average SO2 data from network stations
- Trends in ground-level concentrations and wind data
- Forecasts of meteorological conditions
- Estimates of worst case concentrations

The CCR supervisor monitors the predictive model display data on an on-going basis in order to assess the level of operation which he/she should authorize for the converters. The decision is based on a prediction of the maximum concentration level that can be expected for the predicted meteorological situation, as well as the current monitor readings and projected trends of SO2 concentrations and of wind speed.

Description of Meteorological Conditions

Unstable

Unstable (convective) conditions will occur primarily during the spring and summer days when skies are mostly clear and winds are moderate to light. In order for convective conditions to develop, there must be sufficient heating of the ground to produce rapid warming of the air near the ground. Typically, the lower level temperature on the Sudbury INO Smelter meteorological tower will reach a minimum in the morning before sunrise and will increase rapidly after sunrise to a maximum by early afternoon. This develops an unstable layer which grows in depth as the heating continues through the day. The critical period for the plume is around mid-to-late morning, depending on the time of year, when the mixing height grows to a level such that the plume is just trapped within the unstable layer. Following this period, as the convective regime is firmly established, the plume undergoes looping, continuing the high concentrations at ground level, generally within several kilometers of the stack.

During the convective dispersion regime, ground level concentrations can fluctuate rapidly due to wind direction variability, as well as the intense level of turbulence. This makes it difficult to predict where the plume will be impacting or the level of the resulting concentration.

High Wind Neutral Conditions

When the weather situation leads to significant cloudiness either during the day or at night, or where the winds are sufficiently strong to break down significant stratification the dispersion is said to be neutral. This means that turbulence is at a moderate level leading to a cone shaped plume so as not to cause high ground level concentrations.

For stack conditions which provide little buoyancy to the plume, if the wind speed exceeds about 25 km/hr. the plume will downwash on the stack, potentially leading to higher ground level concentrations within a few kms of the stack. Similarly, high winds which follow the passage of a cold front can lead to the same kind of down-washing and higher ground level concentrations. For most of the moderate wind cases, there will be no problem in maintaining the limit concentration level for single converter operation if the converting is not continuous over the entire hour. The neutral condition is by far the predominant stability.

Stagnation/Light Wind Condition

When the weather system is such that very little wind is generated, the material released from the stack cannot be transported out of the region and the concentrations will build up over time. If this condition is allowed to persist for several hours, the 0.34 ppm limit may be exceeded. (The limit will be lowered to 0.25 ppm January 1st, 2016)

This situation is particularly difficult to control. To be effective, the shutdown of the converter operation must come before significant SO2 concentrations are measured on any of the monitors. If action is delayed to the point that the stagnation condition has already set in, then the materials already released from the stack have no chance to move out of the area.

The stagnation condition can, under certain circumstances, last for the better part of the day; however, its development is well predicted by the forecast program. An alarm has been set up to alert the CCR Supervisor that the wind speed is decreasing and is likely to stay below 4 km/hr. level, indicating stagnation condition.

The primary control criterion is this situation is the trend on wind speed at the upper level of the tower. The wind direction in this situation is not a reliable measurement, and for really stagnant conditions, the air will be moved from one direction to another over the period of minutes, so that the affected region cannot be predicted.

When the wind speed trend indicates that within the next period of one hour the wind speed will fall below 4 km/hr., then visual checks are done on the plume behaviour. If it is evident that the plume is not dispersing then all converter blows will be disallowed until the trend indicates that the wind speed will exceed 7 km/hr. within the next period of 60 minutes. After control has initiated on the basis of the trend on wind speed, it is necessary to monitor the onset of the predicted stagnation condition.

If it is apparent that the condition does not materialize as predicted, the converter operation can be reinstated at one converter level if the other indicators do not rule this out.

A second condition for control in stagnation situations occurs when the actual wind speed, as a rolling hourly average, is less than or equal to 4 km/hr. This again requires visual observation of the plume in order to determine if the plume is dispersing properly or whether a stagnation situation has set in, then a shutdown is required. Thereafter, if the actual wind speed, as a rolling hourly average, returns to 4km/hr. or greater for three or more five minute periods, operations may resume.

Non- Critical Conditions

The non-critical conditions are those which do not lead to exceedences of 0.34 ppm for the hourly average when the converter is operated on a 40 minute basis for the hour. These include some of the neutral regimes as well as the stable conditions for single converter operation at remote monitors and other conditions when the plume us in unpopulated areas. If a non-critical regime is identified, then the converters can be operated without any constraints on the amount of blowing time within the hour.

Since the meteorological forecasts can be amended at any time when conditions warrant it, and since the observed meteorological data can indicate a change in the conditions on a 5 minute update basis, the non-critical regime can be terminated as abruptly as it starts. Accordingly, the CCR Supervisor must maintain a constant watch on all of the indicators, even during non-critical regimes.