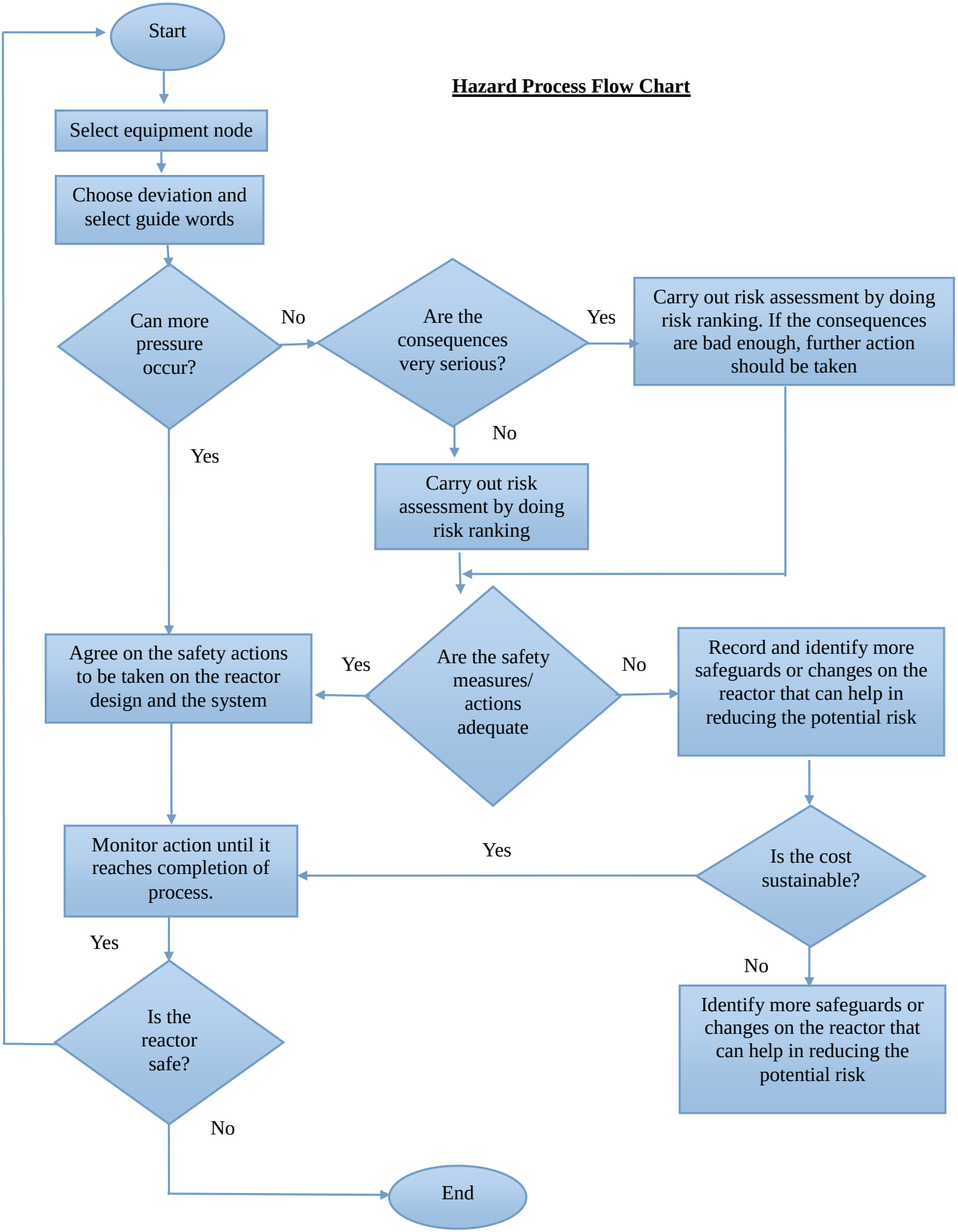
Hazard Process Flow Chart



HAZOP analysis

According to Wikipedia (2015), hazard and operability or also known as HAZOP is a structured and systematic examination used to evaluate and examine system as well as the risk management. Basically, it is used to identify potential hazard or problems that may occur and bring risk to personnel, equipment or lead to nonconforming products (PQRI, 2015). Basically, it is a qualitative analysis and based on the assumptions of design and operating condition to be the causes that lead to the deviations in any operation (PQRI, 2015). Although initially HAZOP technique is developed to analyze chemical process system as well as the risk management, however it is now has been improved to many wide range complex operation usage.

Guide words

Basically, guide words are used as the supporting elements in HAZOP execution as well as to complete the design of the system. Based on Wikipedia (2015):

Guide word	Meaning
NO OR NOT	Complete negation
MORE	Quantitative increase
LESS	Quantitative decrease
AS WELL AS	Qualitative modification (increase)
PART OF	Qualitative modification (decrease)
REVERSE	Logical opposite of the design intent
OTHER THAN	Complete substitution
EARLY	Too early than it supposed to be
LATE	Too late than it is supposed to be
BEFORE	Earlier then the sequence it supposed to be
AFTER	Later then the sequence it supposed to be

By investigating the operating condition of the system particularly on the reactor of continuous flow stirred reactor, we can relate them with hazard and operability (HAZOP). Below are the possible failures or potential hazard that can occur and affect the efficiency of the reactor in the system:

Guide word	**Deviation**	**Causes**	**Consequences**	**Actions**
Not	No flow flowing into the compressor	Control valve closed	Causing increase pressure in the compressor	Equip with pressure relief valve in the compressor

More	More pressure in the reactor	Compressor control failure	Tank or reactor will operate at very high pressure	Trigger automatic emergency shut down
Less	Less residence time for the reaction	Valve opening malfunction	-Inconsistent initial concentration -Less than optimum yield	Periodic maintenance or check up on the valves
As well as	Too high temperature in the reactor (as well as)	Hot steam valve entering reactor failed	-Damage the equipment in the reactor as well as valve, pump, sensor and transmitter -product yield not at the optimum quality	Equip the reactor system with fail-open or fail-close valve system
Part of	Very low pH value recorded in the data (part of)	pH meter failure	Deviation from optimum pH value for reaction may lead to unnecessary pH controller to the system	Use more sensitive pH meter or use the latest technology of pH meter
More	More total solid content going into the reactor	Compressor control failure	Pump and mixer hard to adequate with the solids	Use a fail-open or fail-close valve
Less	Less total solid content going into the reactor	Compressor control failure	Decrease oil conversion efficiency	Use a fail-open or fail-close valve
Not	No flow	Control valve closed	It can cause bursting of pipe	Trigger automatic emergency shut down and do

				periodic check up

Based on the data recorded, some safety measures had been identified by arising some of the potential deviation that may occur with the help of the provided guide word. The safeguard action measures are highly recommended to be apply in this reactor. For example, by equipping pressure relief valve, automatic emergency shut down as well as by doing periodic check up on the equipment. The failure or the deviation that can occur on the reactor had been identified and avoided hence helping in yielding better quality of bio-oil through hydrothermal pyrolysis.

References

Wikipedia. (2015). Hazard and operability study. Retrieved from https://en.wikipedia.org/wiki/Hazard_and_operability_study.

In text reference: Wikipedia (2015)

PQRI. (2015). Risk management training guide: Hazard & operability analysis (HAZOP). Retrieved from www.pqri.org/pdfs/mtc/hazop_**training_guide**.pdf.

In text reference: PQRI (2015)

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