ENGINEERING AT FOOD MANUFACTURING PLANT PREMISED ON HACCP OPERATION

- ENGINEERING CASE STUDY OF FOOD SAFETY IN JAPAN -

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< Abstract >

As Nisshin Engineering has been offering the engineering service of food plant for over 30 years, we are experienced with so many various situations of food plant construction. Today, we are focusing on the case study of basic plan of new food plant producing lunch box. In this case study, we are going to discuss on the engineering approach of food plant basic planning, which is one of the most important key steps & technologies.

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1. INTRODUCTION

Food poisoning incidents four years before were of the largest scale in postwar Japan. Not only the relevant food corporations, but many other food related businesses have received extensive complaints from the consumers because of food related incidents such as food poisoning and mixture of foreign substances. This is now undermining reliability of food safety.

The mission of the food corporations is to supply "safe and reliable food." They have to try every method to secure safety, wholesomeness and soundness of food.

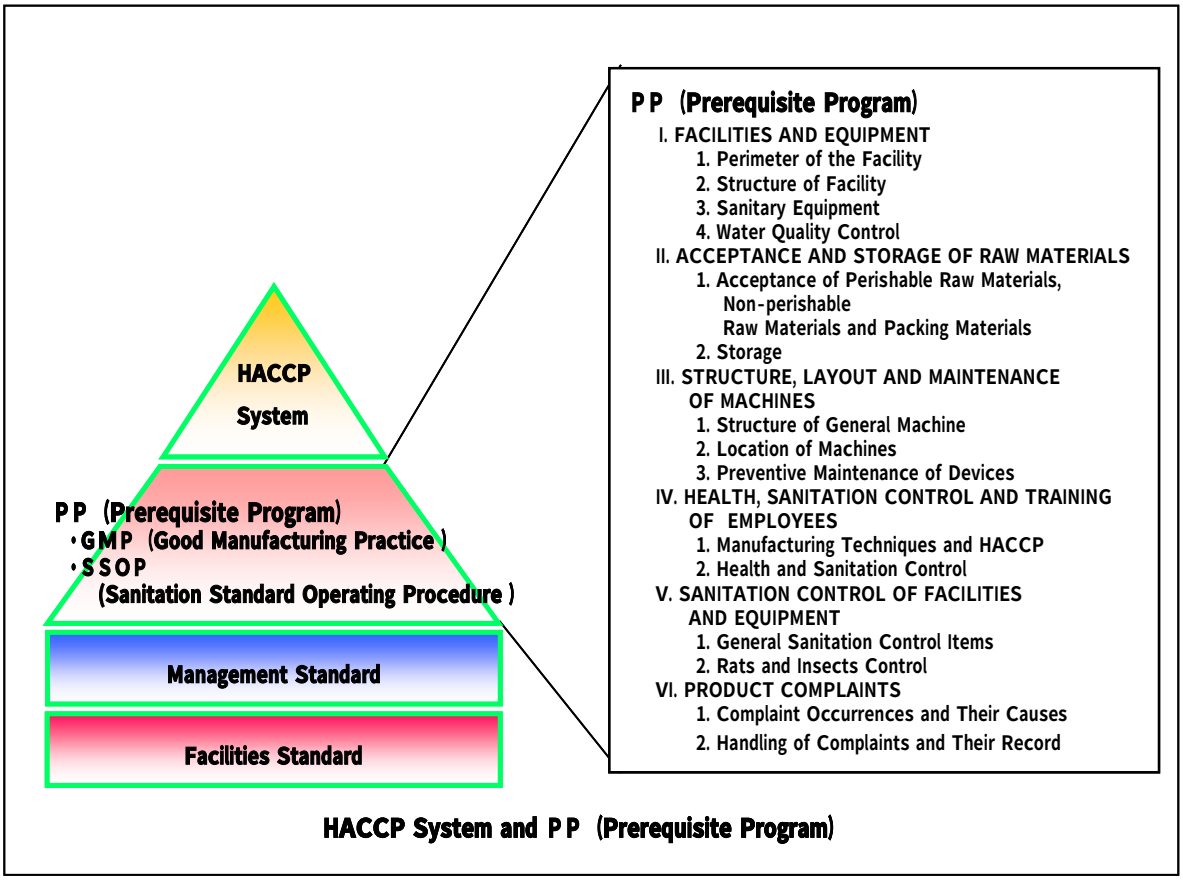
The HACCP system is effective as one of these methods and has been positively introduced all over the world. We initially heard of "HACCP" in the beginning of the 1990, but there are now very few people in the food industry who do not know it. Coverage of the above-mentioned food poisoning incidents by mass media helped the system's social recognition. Not all people may understand the HACCP system well, but it is also true that

some people say, "the HACCP system is not good enough to secure safety of food." For the "entire food industry" including every food related field as well as food manufacturing companies, it will be necessary to bring it home to general consumers that if the HACCP system had been operated as it is intended, those incidents would not have occurred and demonstrate its effectiveness to deepen their understanding of it.

In the future, introduction of the HACCP system into their manufacturing fields and its strict operation (planning, execution, and verification) are more requested to the food business. In such circumstances, we have been recently constructing plants compliant with the HACCP system as an engineering corporation engaged in construction of food manufacturing plants. We would like to present what we have in mind, based on our track record.

2. IMPROVEMENT OF HACCP SYSTEM AND HARDWARE

Upon introducing and operating the HACCP system, it is essential to improve a PP (Prerequisite Program), which is a prerequisite of the HACCP system for the system to function effectively and smoothly. The PP is roughly classified into GMP (Good Manufacturing Practice) for hardware (facilities, equipment, etc.) and SSOP (Sanitation Standard Operating Procedure) for software (management, administration, etc.). It is necessary to improve both hardware and software in parallel.



HACCP System and PP (Prerequisite Program)

In considering the HACCP system, however, a balance of hardware and software naturally depends on whether the plant is of apparatus-oriented or labor intensive type, and whether it is a new or existing one.

If it is the apparatus-oriented plant, there will be less areas that must be complemented by software if hardware is highly improved. This aspect seems to be contributing to relatively advanced introduction of the HACCP system in the apparatus-oriented plants.

In case of labor intensive plant, on the other hand, if improvement of hardware (zoning or setting of a physical barrier) is made stricter, the plant will have less freedom and will be troublesome for workers; if priority is given to freedom in work, to the contrary, you will have to bear a greater burden in software operation.

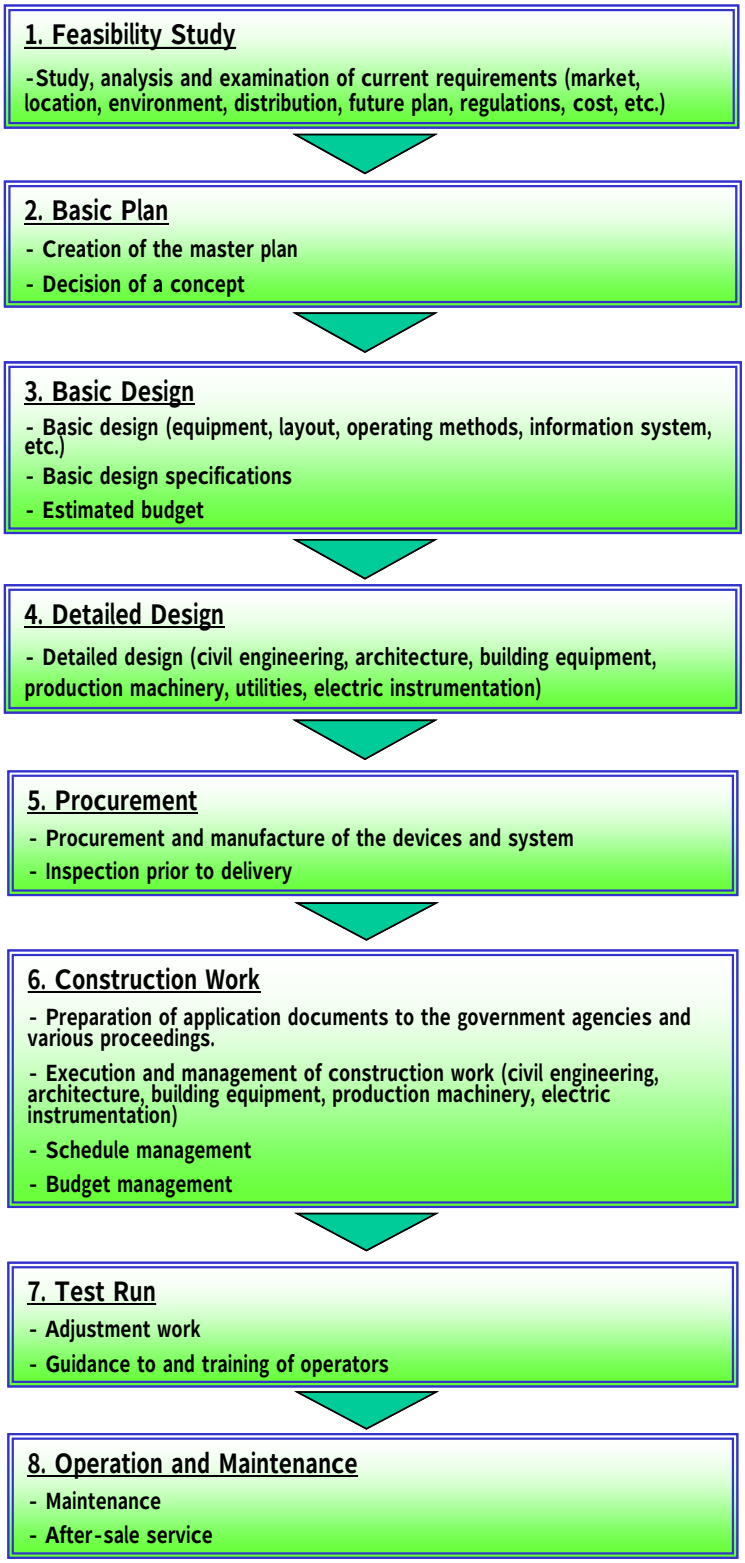
In the case of a new plant, realization of "what it should be" and improvement of hardware are relatively easy by designing the plant considering the operation of the HACCP system starting from the planning phase. Improvement of software can be carried out in parallel. Existing plants need renovation and have to solve various obstructive factors such as space, cost, shutdown period, and lower work efficiency. In some cases, you may have to make a compromise to rely on operation with software. If this is the case, quality of the HACCP system could be low.

Due to the facts described above, it is presumable that setting and standardization of hardware level (although it is naturally a voluntary standard) are fairly tough matters in the current circumstances. However, importance of improvement of hardware is solid, judging from the fact that quality of hardware has a direct effect on operation with software.

For these years, we have regarded that the HACCP system is introduced in food manufacturing plants as quite natural when constructing them. The following mainly states our ideas on engineering work in construction of labor intensive plants and improvement of hardware in the HACCP system.

3. FLOW OF ENGINEERING WORK IN CONSTRUCTION OF FOOD MANUFACTURING PLANT

The engineering work in plant construction is to be carried out in the flow shown in the figure.



The following describes the procedures of food manufacturing plant construction along the flow of the engineering work.

1) Feasibility Study

A business project is proposed by a business proprietor and various analyses are made on it. Among external factors such as the market, conditions of location, legal regulations, environmental measures, and internal factors such as a personnel plan, sanitation control, automation, future plan, you make a rough program and compare it with a funding program to examine whether the business will be successful. The business project starts if its implementation is decided.

2) Basic Plan

Once the project starts, you have to initially decide your concept including what kind of plant you want to construct or should be constructed to unify awareness of the project members. Based on the concept, you set a production plan, personnel plan, master schedule and process flow to create the basic plan.

3) Basic Design

To actualize the master plan, you must decide basics and framework in this phase, such as an overall configuration plan, layout plan, elevation plan, zoning plan, flow plan.

The results of the basic plan and basic design are directly linked with the final performance of the plant. Therefore, it is necessary to invest great energy into design and examination as to what kind of plant you want to construct. Highest priority should be also given to full examination of the HACCP system in this phase.

4) Detailed Design

Based on basic design, you design facilities required for construction in detail, such as civil engineering and architectural design, building equipment design, utilities design, production equipment design, electric instrumentation design. Furthermore, you examine mutual connections, considering cost performance in line with basic design, and prepare the specifications and drawings for implementation.

5) Procurement

6) Construction Work

7) Test Run

8) Operation and Maintenance

Taking design considerations into full account, you proceed to the plant construction phase at the site. Material procurement and construction work must be thoroughly managed so that the construction work methods and term of works for each process will be properly satisfied, causing no mistakes in construction work. In order to finally actualize the quality assumed at the time of design, management of design and construction work plays a very

important role in these phases. Together with them, management of the schedule and budget is also essential.

After construction work is completed and all the equipment is tested, you actually perform test run of the manufacturing system. The problems detected in this phase should be examined and solved quickly and adequately to prepare for actual operation.

4. HARDWARE PLANNING

To ensure product safety and uniformalize product quality, in which phase should the concept of HACCP be introduced?

Starting from the phase of feasibility study, it is necessary to assume operation of HACCP. By introducing the HACCP system, you must not only ensure product safety, but assume the sanitary level of the plant beforehand. You need to make consideration of costs including initial cost for improving hardware and running cost for operating the HACCP system in this phase.

Then, you proceed to actualize preparation of plant hardware in the design phase and the most important point is how to address the HACCP system in the master plan and in the basic design phase. What you have to do first in this phase is to decide a process flow and work flow chart. Based on this flow, you will analyze and examine hazardous factors in the process and plan the following, taking those factors into account:

1. Layout plan
2. Zoning plan
   - Classification of cleanliness
   - Classification of dryness/wetness
   - Classification of air pressure
3. Flow plan
   - Flow lines of things
   - Flow lines of personnel
   - Flow lines of food container boxes/push cars
   - Flow lines of waste

Here, you need to pay heed to the following items:

1. Prevention of cross contamination and secondary contamination
2. Shorter distance of flow lines (Particularly, minimize the flow lines of the objects which could become contamination factors)
3. Location of the machines and devices
4. Work space and storage space
5. Work efficiency and personnel placement

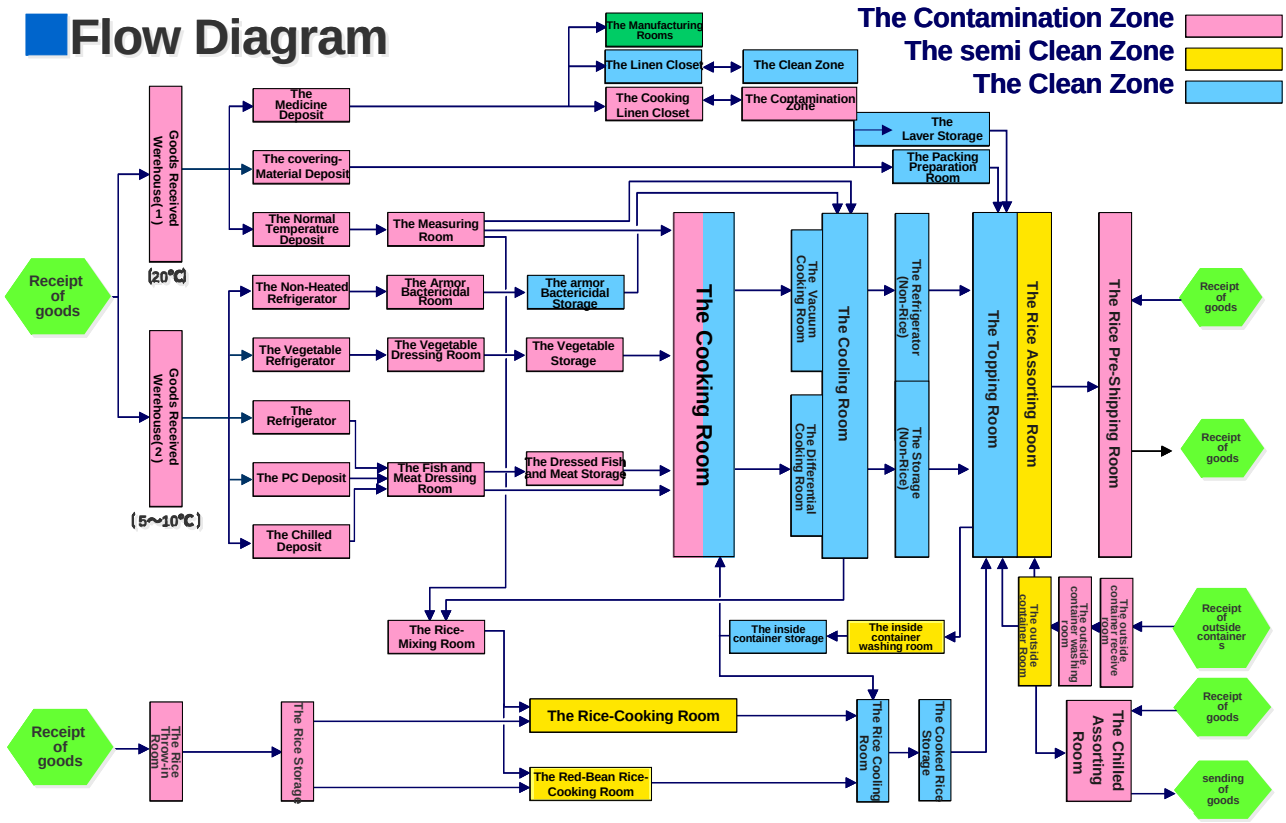
6. Easy sanitation of the structures and devices

7. Prevention of insects and rats

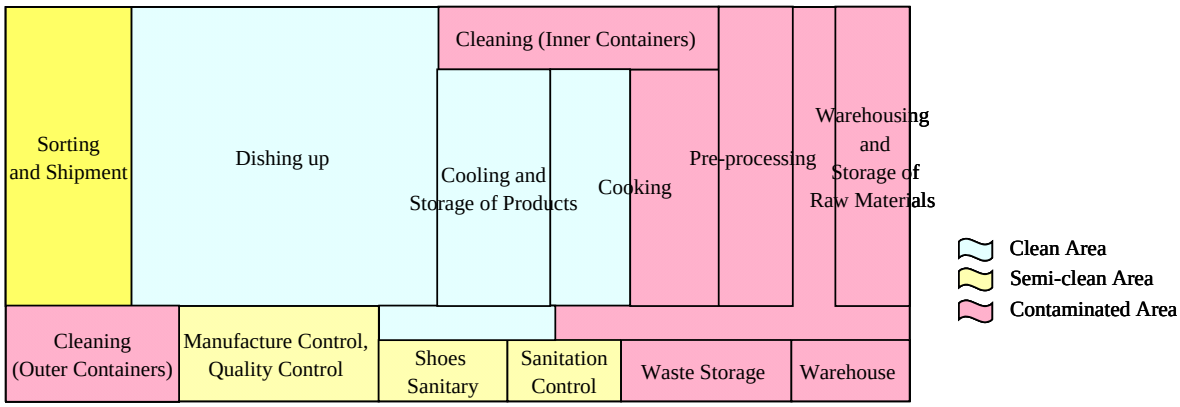
8. Handling of waste

9. Flexibility at the time of remodeling, renovation and extension

It is important to proceed with design, concerting hardware and software with each other. In each plan, you need to fully examine validity, consistency, operating methods and work efficiency, avoid easy compromise as much as possible and materialize "what it should be" to the maximum, even if you have to go back to the beginning. Basic design with the HACCP system in mind at this point will play a great role in sanitation management and operation of the HACCP system after the plant has started running.



Zoning Concept



(1) Classification of Contaminated and Non-contaminated Areas

3 levels of cleanliness are used in this project; clean area, semi-clean area and contaminated area. This classification is to standardize the sanitary levels of the materials and products handled in each room of the plant and work details.

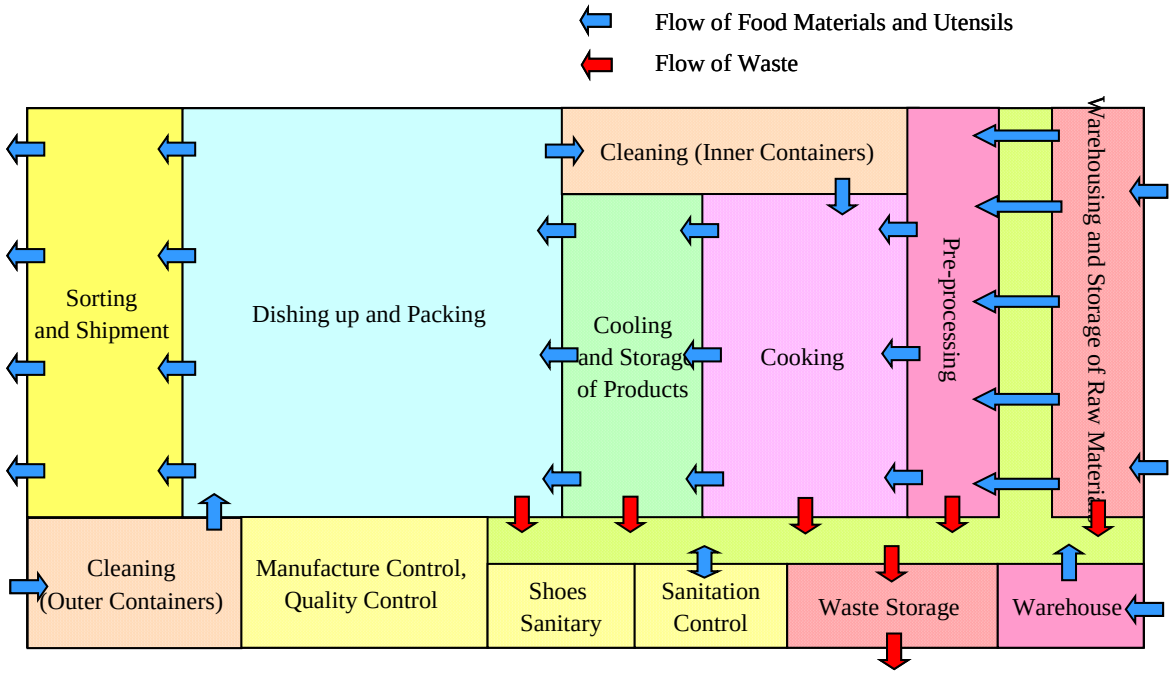
(2) Classification of Dry and Wet Areas

When a push car or worker enters a non-contaminated area from a wet area, the work environment should be analyzed to prevent contamination of the floor, materials and products in the non-contaminated area.

(3) Classification of Air Pressure Distribution

Each area should be differentiated to prevent entry of insects or floating germs into a manufacturing area inside/outside the plant as much as possible and maintain the temperature and humidity levels in each room.

Flow separation of food and waste



Furthermore, more detailed specifications should be included in order to prevent hazards in each process in detailed design.

When doing this, the following items are the basics:

<1> Structure and specifications which do not allow entry of hazardous factors (microorganisms, insects, rats, foreign substances, etc.) into the plant or production facilities

- Air tightness of the exterior and interior
- Air tightness and finishing methods of the goods inlet and outlet, entrance and exit, openings, etc. and installation of the prior rooms
- Method, structure, location and air pressure balance of air supply and exhaust ports
- Illumination plan

<2> Structure and specifications which do not allow increased hazardous factors in the plant and production facilities

- Selection of antibacterial materials
- Dew condensation preventive measure (Material, heat insulation, air conditioning method, etc.)
- Accumulated powder, accumulated dust, standing water, realization of dryness
- Drainage plan such as a drainage system, tilts, traps
- Control and monitoring of the temperature and humidity

<3> Structure and specifications which allow easy elimination of hazardous factors in the plant and production facilities

- Smoothness and detergent properties of the materials
- Chemical resistance and corrosion resistance of the materials
- Illumination plan, and disinfection and insecticidal devices

Together with them, the following are also to be considered:

<4> Sanitation method

<5> Monitoring method

Generally, food manufacturing plants cannot easily spare time for repairing and improvement of each facility/equipment, but severe working conditions are imposed to the floor of the boiling pot areas and hot water drainage areas in the heated cooking room. In order to minimize repairing work, durability should be fully examined in selecting floor materials.

In addition, you also have to assume necessity of extension and remodeling works attributable to changes of the raw materials, items, cooking methods, etc. It is desired to take into account flexibility of the layout of the facilities and equipment, and the specifications, so that responses to those changes are not big burdens to bear.

Finally, it is naturally necessary to consider a balance with costs.

Even if hardware preparation has thus reached a satisfactory level, improper software preparation could lead to insufficient operation as the HACCP system.

In that sense, we believe it essential to bring "5 S's" home, which are basics for everything.

[Bringing "5 S's" Home]
Arrangement (Seiri): Stagnation control of a flow of things. Classify whether necessary or unnecessary
Tidying up (Seiton): Manage definition and indication of things so that they can be used whenever necessary.
Cleaning (Seisou): Elimination of foreign substances. Get rid of dust and stains.
Cleanliness (Seiketsu): Maintenance of cleanliness. Clean the workplace.
Discipline (Shitsuke): Manage work so to observe the regulations.

[4 Steps for Arrangement and Tidying up]

1. Eliminate unnecessary articles. (An usable space is produced by eliminating unused articles, even if you think that they will be used someday. Basically, allow only minimum requirement in the workplace.)
2. Store necessary articles, depending on their frequency in use. (Store more frequently used articles on the near side and less frequently used ones on the lower shelves or in the warehouse.)
3. Once the storage place is decided, put up an indication and avoid putting other things.
4. Make it a habit to immediately put back the used article to its fixed storage place.

5. CONCLUSION

The construction trend of the food manufacturing plant has changed to various styles, but there has been no change made to the proposition to construct a plant designed to provide tasteful, uniform, safe, and "high-quality products."

With this proposition being as the first principle, NISSHIN ENGINEERING has been grappling with plant construction in concert with users. Plant construction, composed of various elements such as civil engineering, architecture, building equipment, production equipment, electric equipment, information processing equipment, drainage equipment, etc. requires enormous amount of work and we must put them up functionally and efficiently. We believe it our role to understand all of those elements and put them up unitarily in the user-desired direction through close cooperation.

We are an engineering company which has a food company as its parent and have constructed a variety of food manufacturing plants. Not only feeding back food

manufacturing know-how in the manufacturing field, but based on our accomplishments of plant construction other than food manufacturing plants such as medicines, fertilizers, forming goods, toiletry goods, and distribution center, we are capable of providing users with plenty of knowledge and experience.

From a standpoint of providing the engineering work in plant construction, we would like to contribute to future development of the food industry.