NATIONAL CENTRE FOR COLD-CHAIN DEVELOPMENT

राष्ट्रीय कोल्ड-चेन विकास केंद्र

Guidelines & minimum System Standards for Implementation in Cold-chain Components

FOR SCHEMES SUPPORTED BY CENTRAL GOVERNMENT

DEPARTMENT OF AGRICULTURE AND COOPERATION
MINISTRY OF AGRICULTURE
GOVERNMENT OF INDIA

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SECRETARY

सत्यमेव जयते

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Government of India
Ministry of Agriculture
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MESSAGE

Development of Cold-chain is a key thrust area under the Ministry of Agriculture. Cold-chain is treated a part of the second green revolution as it addresses "end-to-end" connectivity from farm gate to consumers in a seamless manner. The centrally sponsored schemes under Department of Agriculture and Cooperation were revised to incorporate various changes and additions to the cold-chain components being supported, requiring associated revisions to technical guidelines.

I am happy that the compendium on 'Guidelines and minimum System Standards for Implementation in Cold-chain Components' prepared by National Centre for Cold-chain Development (NCCD) in consultation with various Government agencies, industry stakeholders and the national level Committee on Technical Specifications and Standards is now available for circulation and dissemination.

This document provides improved understanding to stakeholders about various cold-chain infrastructure components. The guidelines are intended to streamline and accelerate the pace of cold-chain development in the country.

These System Standards lay down the minimum requirements for development of cold-chain infrastructure, and are in synergy with Operational Guidelines of Mission for Integrated Development of Horticulture (MIDH).

24th April, 2015

(Siraj Hussain)

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Preface

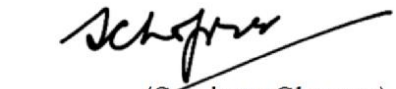
The National Centre for Cold-chain Development (NCCD) was selected as a National Level Agency under the Mission for Integrated Development of Horticulture, with the mandate to provide specific inputs to guide policy and set standards for development of integrated cold chain in the country, for perishable fruits, vegetables and other allied agricultural commodities to reduce wastages.

This document is the result of efforts by NCCD, through contributions from a series of interactions with stakeholders in this sector. The inputs from various government agencies involved in cold-chain development have furthered the deliberations leading to this document. The members of CII's Task Force on Cold Chain, under guidance of its Chairman, have closely interacted with NCCD to endorse the contents. Technical inputs and recommendations of the PHD Chamber of Commerce and Industries and its Task Force on Logistics Management were also incorporated. NCCD's in-house expertise played a key role in authoring this guidance for cold-chain development.

The Mission for Integrated Development of Horticulture (MIDH) sees cold-chain infrastructure as a key tool for the farmers in the perishable segment of horticulture. Ably applied, the cold-chain serves to empower the farmers by providing logistics technology that makes it feasible to reach a multitude of consuming areas. Not merely, extending the reach of farmers markets across geographies, the cold-chain also serves as the custodian of quality and value that is produced their efforts. The cold-chain, therefore, helps to connect farmers with markets which is key to overall growth of the horticulture sector.

Through effective and efficient market linkage, perishable produce from horticulture is able to maximise upon its potential, by not only realising optimal value to the growers, but also by providing cause to farm more quantities, produce better yields and use more resourceful technologies. The supply chain networks that ensue, also make sure more of the food is delivered to consumers, less is lost in its delivery, and allows for more stable economic trends.

It was with this consideration, that cold-chain is provided utmost support and designated as a thrust area under MIDH. This document is created in synergy with the system components supported under the MIDH Operational Guidelines and enumerates the minimum system requirements, when supporting such development.



(Sanjeev Chopra)
Joint Secretary (A&C) and
Mission Director, *MIDH*

About the Document

The National Centre for Cold-chain Development (NCCD) was constituted under the Department of Agriculture and Cooperation (DAC) as an autonomous body, having received sanction from the Cabinet on 9-February-2012. NCCD functions as a dedicated institution to pioneer Excellence for development of cold-chain in India. NCCD is required to take the lead role in cold-chain development by implementing ongoing demand driven activities and processes. NCCD is tasked with guiding policy and setting of minimum standards for the development of integrated cold-chain in the country, for perishable fruits, vegetables and other allied agricultural commodities to link with markets and works in close collaboration with industry and other stake holders.

It was clear that cold storages alone, as middle links in the larger concept of the cold-supply-chain, would not suffice for the cold-chain needs of all possible product and crop types. Keeping this and other inputs in mind, the newly launched Mission on Integrated Development of Horticulture (MIDH) included some very novel and direction setting components in its operational guidelines.

Various missing links in the total supply chain and components that alleviate some of the pain points to holistic development have been considered and included in the MIDH Operational Guidelines. The scheme was also rationalised to move from mere storage based development towards a supply chain based approach to development. These components enumerated are key to developing relevant infrastructure and the assistance pattern also provides direction to induct a technology base such that the infrastructure is more future ready.

This contents of this document incorporates the minimum norms in the erstwhile technical standards (namely NHB-CS-Type 01 to 05) developed by Department of Agriculture & Cooperation and redefines the components as per extant MIDH Operational Guidelines. The cost norms referred to in this document are relevant to the extant guidelines.

This document defines & describes the concept and application of cold-chain components supported under MIDH and allied agencies and provides remarks & recommendations for the users. A Datasheet for each component that needs to be filled by beneficiary seeking subsidy is also provided under Appendix-1. The components that are supported by the Government are intended to promote market linked supply chain integration, in the cold-chain.

In understanding that cold-chain development had numerous aspects to it, and that it offers varied business models to entrepreneurs, comprises multiple technologies, is highly cross functional in operations, and is essentially a specialised supply chain concept, the approach adopted was to focus on the value chain across operational segments in the required logistics network.

Revisions to these technical standards and adherence protocols shall be updated by NCCD as necessary, when improved technologies and efficiencies are introduced / understood / approved.

(Pawanexh Kohli)
Chief Advisor & CEO

Table of Contents

INTRODUCTION

Cold-chain as an Enabler

Commonly understood as temperature controlled warehousing and transport, the cold-chain involves control of temperature, humidity, air composition, packaging and more. The cold chain offers many opportunities and two basic aspects of its applications are summarised as follows:

A. Preserving a product's quality. This is best exemplified in case where cold-chain technology is deployed to primarily protect goods from inclement natural or ambient conditions. In this function, the cold-chain has a more of a preservative effect on the cargo it protects – there is no extension of products' storage life, only a function of preserving its state by maintaining predetermined ambient parameters. These product types are ice cream, meats, most processed foods, vaccines, many chemicals and plastics, electronic goods, etc. These product segments have a clear-cut product expiry period, linked to the ingredients added and the production or manufacturing process. The 'expiry-date' or 'sell-by-date' is maintained by subjecting the package to predefined temperature parameters; whereby the predetermined product quality is secured by the cold-chain to great accuracy. The price discovery is pre-ascertained and product is labelled accordingly.

In such cases, the production unit or factory is the origin of the cold-chain and the new value that is created at point of origin is preserved for market realisation by cold-chain services. Here, cold warehousing and transport ensures or preserves the goods in a state of pre-determined expiry, with the value and selling date of each package having been defined during the production process.

B. Enhancing the produce's life cycle. When we consider cold-chain for fruits and vegetables in fresh form, primarily living perishables, the cargo under care benefits from an enhanced life cycle. The cold-chain when applied correctly, effectively extends the produce's living cycle and safeguards nutrient quality. Though the produce trends on a perpetual, downward biological life cycle, the ageing process is retarded, buying time to reach consumers. Such cargoes are sold fresh and the value impact is not merely because of the temperature control, but also due to many other aspects, which are akin to biological care. When handling farm fresh produce, the cold-chain services need to be more accurate in all its practises, as these are not packaged products but packaged freshness; cold-chain has to manage humidity and microbial conditions, requires to maintain oxygen levels at breathable limits, monitor & control degenerative gases, segregate to avoid tainting between living tissues, and all the while continuing to maintain precise temperatures.

Excess cooling is harmful and a couple of degrees warmer means faster product demise; any parameter disruption will impact the product longevity and price realisation, both of which are variable. An accurate measure of the produce life cycle is not always possible as it is dependant to pre-harvest conditions too. The cold-chain is merely utilised to retard physiological changes and buy some time. The produce is subject to more dynamic price discovery mechanisms, basis demand, market access and freshness.

In such cases, the cold-chain is used primarily to derive benefit from the temporary enhancement of life cycle, by using this period to connect with more consumers and to balance episodic harvest periods. The pack-house, transport and cold stores system involve superior skills in their operations with knowledge about the produce under care. This is well

understood in case of fresh milk, fresh mangoes, fresh grapes, etc. and the sensitivity of these value chains is frequently evidenced. The product being handled is not a product manufactured under controlled processes, but harvested produce with its originating quality being subject to vagaries of nature. Cold-chain should therefore not procrastinate, but hasten the farm to consumer cycle.

The concepts A and B are two ends of a spectrum – one is a preservative function, the other serves to delay senescence and enhance saleable life. The use of either function depends on the product and produce types. A combination thereof of these underlying principles are also seen in use (potatoes, spices, pulses and select apples are examples). Understanding the principles involved helps users devise suitable designs and networks. Nevertheless, cold-chain is a specialised logistics system that serves as a conduit to carry and safeguard value, which was either manufactured or harvested, from source to end-consumers.

Agriculture-Industry connect

Cold-chain is an industrial technology, and as an application has extended itself from a merely preservative role into a larger life enhancing solution for the fresh food sector only recently. Yet, globally, the latter and its ability to link fresh foods with markets across vast distance has become its main function. Cold-chains have become the prime link between a long existing production base (the farms) and consumption centres.

Cold-chain Solution

Right combination of -

- *Harvesting*
- *Routing*
- *Packaging*
- *Cooling*
- *Staging*
- *Transport*
- *Storage*
- *Distribution*
- *Retail*

In case of horticulture, though the farming base is low cost, it can benefit the most from the cold-chain. When handling fresh horticulture produce, the modern pack-house is the key post-harvest point, which prepares the fresh produce to enter the cold-chain conduit. After being conditioned for the cold-chain, the majority of the produce enters the transit phase to markets. This transit requires reefer transport and close to market cold storages. At these cold stores, designed as distribution centres, the produce is deconsolidated into demand based lots for distribution to retail outlets for consumers to access. Each handling component, the pre-conditioning stage, transitory storage and transport, close-to-market storage for distribution and retail, requires special care, besides basic temperature control, as explained earlier. The cold-chain is not essential for the farmers to produce, but is necessary to reach far away markets – it empowers them with the ability to capture a larger buyer base and helps to bring their harvest to more valuable end use. Conversely, an ice cream factory for example, can exist only with the assurance of a temperature enabled supply link.

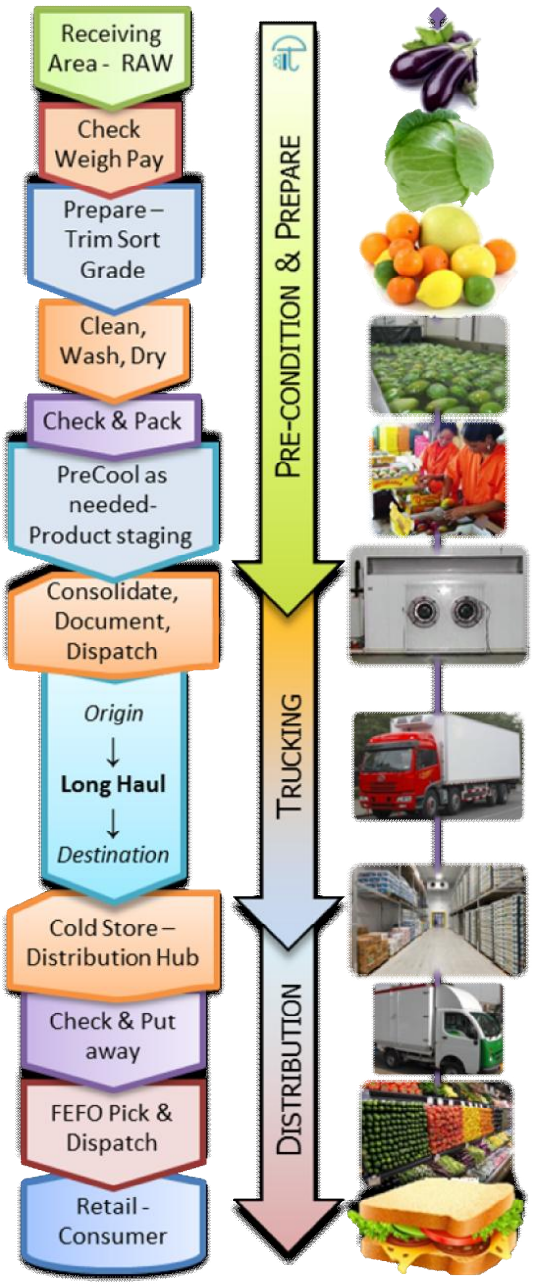
Pack-house Origins

Pre-conditioning of the produce after harvest is of primary importance. As a part of this activity, produce is first assorted by value and designated into market lots, even before the energy application phase of cold-chain. The fresh produce that can be realise value in the immediate vicinity is not subject to further energy inputs. This implies that the modern pack-house, as the start-point of the cold-chain, also become the originators of other supply links which may not require temperature control. Fresh Produce that can be sold locally is routed accordingly, that which can be processed into a product goes to the local processing factory, and that which needs to link to distant markets enters the temperature conditioning phase. Pack-house is the point of origin and is the key decision maker for routing of perishable agriculture produce

Hence, a pack-house initiates multiple market routing or value realisation options. If the routing requires long travel, then packaging for safe transport is the next necessary step. Packaging lines can be used and the package designs are specific for fresh produce. After packaging, the precooling stage is entered so as to bring both the produce and its package to optimal temperatures so as to retard senescence. Thereafter, the packaged fresh produce is kept in a transitory staging cold room, pending onwards transport to faraway markets. Pre-conditioning is the preparatory activity for travel to market, the first phase in the farm to fork trip.

Making the connect

Transport is the next link in this chain. For transport, unitised cargo lots are preferred to facilitate safe as well as speedy handling. Globally, the pallet is the common unit load used. The uniformly sized unit loads, are loaded onto carriers – the reefer trucks or larger unit loads like the reefer container. Reefer containers allow the use of rail, road and waterways without multiple handling of the primary goods (fresh produce).



Uniformity in the load units also allow for harmonisation of the handling equipment and promotes standardisation of operations in the cold-chain.

Handle with care

Palletisation of a load facilitates safe multi-modal handling, whilst transporting and when in cold stores. Pallet handling is best done by mechanised means, which ensures quick & easy operations, reducing the loss that occurs due to mishandling. Cold stores are preferred when they are equipped to handle pallet based cargoes, i.e. Fork lift types, roll-on/roll-off ramps, pallet based put away racks, etc.

Modern cold stores, especially those that serve as distribution centres, are increasingly use high reach storage systems and deploy dock shelters, ramps and high reach handling equipment. This also assists in better land area utilisation.

At the last mile, retail shops also need strengthening to handle cold-chain routed fresh produce. In all, the complete chain enhances the produces' usable life, retards loss of freshness, sustains nutritional value to the maximum and contributes enormously by extending the value chain system beyond traditional regions and limitations. The most phenomenal gain is drastic reduction in physical loss, through organised practices, when compared to the traditional multi-layered logistics chain.

Energising the chain

The cold-chain is energy intensive, primarily due to the added need to regulate temperatures at desired levels. The other major energy use is at the need for speedy transportation. In the

future, advanced developments in food processing technologies may one day reduce the dependence on cold-chains, as is already the case with most beverages, products that are pickled, use preservatives and aseptic or UHT processing, freeze drying, etc. In some of these cases, only refrigerated storage at the consumers end is needed, though the need to secure raw produce will continue the demand for first mile cold-chain. However, the complete farm to retail cold-chain is not expected to wane, especially for fresh produce, for the far foreseeable future. With growing incomes and increased health awareness, the consumers' aspirations are expected to move towards fresh foods rather than convenience products. Therefore, the direct conveyance of farm fresh value to urban centres can be expected to be a continued key role for cold-chains.

Good planning, insulation, automation, and utilising alternate sources of energy or hybrid energy solutions is a way to mitigate the energy load of a cold-chain. Innovations that combine individual energy solutions may seem futuristic, but have become a common stance globally. India's cold-chain needs to have opportunity to align with futuristic trends and be long term leaders in the 'greening' of the cold-chain.

Cold warehousing

Some of the crops produced in India can take advantage of long term storage, so as to continue trade even in lean periods. These are mostly those that have a single season harvest across the entire country and are compatible for extended storing periods. Such crop types spend most of their life span inside cold stores, pending optimal demand or price from markets. Such product types enter into cold storages soon after harvest, in bulk and in sufficient quantity to feed the consumer for the most part of the year. Fresh potato and apples are ready examples in India.

Cold stores intended for long term holding of produce are designed close to production areas. They will source produce during harvest season and store in bulk, without undertaking any retail packaging. During off season periods, the chambers are periodically opened and product released to market. Much before the start of the next harvest season, the chambers start to empty out and finally the entire store is emptied and readied for the next harvest. These cold stores can have sorting, grading infrastructure. Packaging lines may also be installed, for use when produce exits term storage phase, for subsequent dispatch to market. Such cold stores can be termed as farm-gate facilities as they effectively are scaled up aggregation centres at source, with large term storage chambers and other appropriate technology options.

The other cold store type is that at the front end of the cold supply chain. It will be designed for transient storage and enabled for cross-docking (fast distribution) operations. Pre-conditioned and packed produce enters this store, having already flowed in the cold-chain – the goods would have originated at a pack-house or from a processing unit. Since goods already arrive in packaged form for retail, there is no need for a pack-house type unit to this infrastructure. In some cases, a large infrastructure which doubles as an aggregation unit for raw produce, will design a pre-conditioning facility for preparing local produce for cross regional travel.

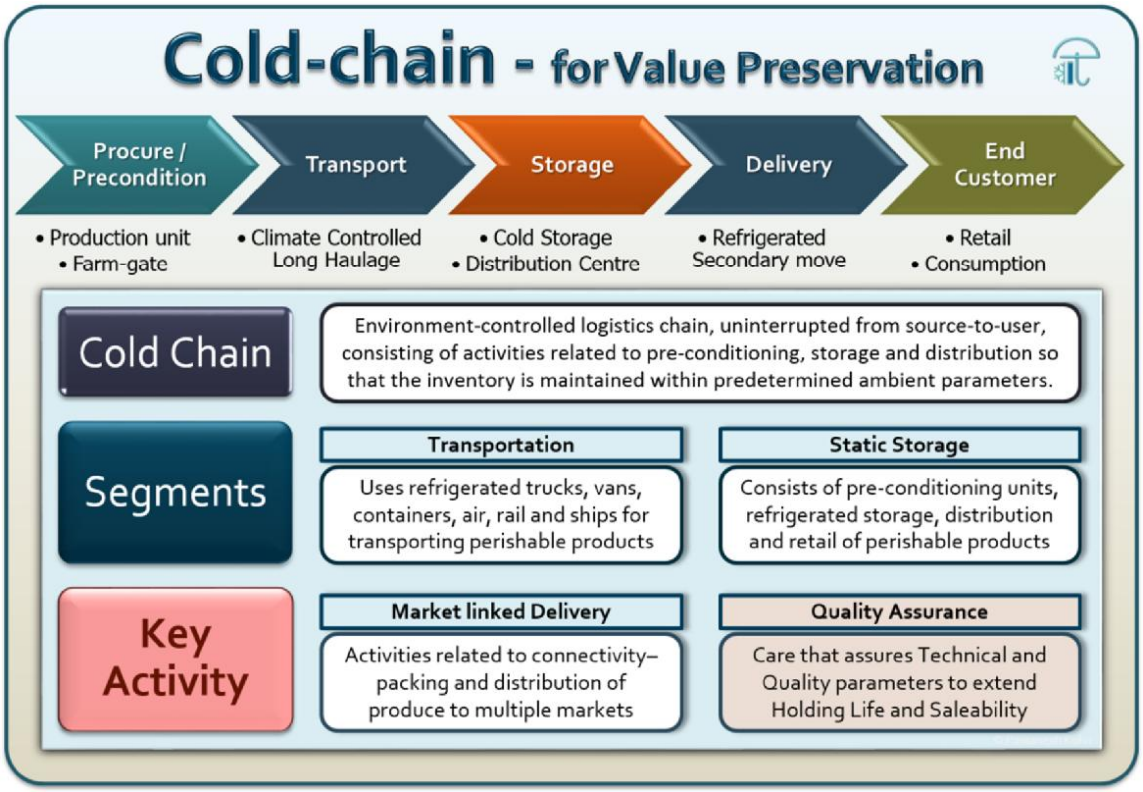
The front end cold stores are distribution centres or hubs, and are a perpetual hub of activity, receiving and dispatching cargo at a daily or frequent basis and are critical infrastructure to serve connectivity to the market. The ante-room, also known as a staging area, is large in size to allow for multiple activities and movements inside such a cold store. These cold distribution hubs are located close to consumption centres, metros and other steady demand centres such as ports and airports so as to serve as a feeding centre.

Standardisation of handling, packaging and equipment is critical to smooth operations and to minimise operational wastage with the storage aspect taking a back seat. The operational needs of the two main type of cold stores differ, as does the associated technical design and sizing of infrastructure.

Ripe for consumption

Ripening chambers are a unique component of the cold-chain and used only in the fresh produce segment. In this segment, whereas the cold-chain operates to extend life by slowing the normal metabolism, the ripening chambers do the opposite and advances the physiological activity. Depending on market demand, ripening chambers are used to manipulate the life extension due to the cold-chain, by adjusting or tweaking the maturity cycle of the produce.

The produce that enters a ripening facility exits the cold store well within its extended life cycle, and the ripening process is triggered. Climacteric fruits like bananas, mangoes and papayas are normally ripened on demand, to meet market requirements. Normally, the produce would otherwise ripen naturally towards the end of their life span. Ripening chambers can also be brought into use for some non-climacteric fruits like for de-greening of citrus fruit.



Ripening chambers are designed to maintain mild-chill temperatures and dose the fruit with ethylene which is a natural ripening trigger. Air circulation ensures that the dosing is spread evenly inside the chamber. A ripening cycle of 4 to 5 days is typical. At the end of each cycle, the ripened produce moves out for retail. The shelf life of ripened produce is minimal and thus, ripening chambers need to be built at the last mile of the cold-supply-chain, close to the consumption base. Ripened produce cannot last long and should not be dispatched for long distant travel.

(Chief Advisor & CEO - NCCD)

About MIDH Operational Guidelines

The Mission for Integrated Development of Horticulture has earmarked post-harvest management as a thrust area. The MIDH Operational Guidelines factor in a comprehensive approach to cold-chain development. Both operating models in cold storages are given consideration, the need to develop pack-houses at farm-gate is maintained, opening up scale and multi-modal options in transport is supported, energy optimisation is valued, ripening chambers and food safety compliance aspects are promoted. These and various other inputs were taken into account when developing its operational guidelines.

The overall approach of the Mission emerges as follows-

a. Provide relevant incentive to private stakeholders to invest in critical areas of cold-chain. These critical needs can be specifically identified by each State Government.
b. All development based investment must aim to interlink with other aspects of the activity chain and/or value chain system.
c. Standardisation of handling units of perishable products should be encouraged.
d. Guidelines and standards should be such as to promote innovation and enhance opportunity in the cold-chain sector.
e. Direction be set to promote alternate technologies and energy sources in the cold-chain with the aim to have a positive impact on the environment. An environmentally aware approach is highlighted.
f. Multi-modal transport options to be encouraged in the perishables logistics chain, especially as speed and good handling is equally critical to risk and loss reduction.
g. Investment in rural areas to be supported in the form of back-end village level pack-houses. The initiative will support Farmer Producer Organisations to participate in cold-chain development and promote near-farm job creation.
h. The technologies application should aim to maximise offtake of farm-gate fresh produce and link with ready markets so as to expand market reach of producer, hasten the value chain cycle and enhance revenue options for the producers.
i. Traceability of farm produce is supported along with appropriate packaging systems.
j. Adaption of low cost technology options in relation to Indian backdrop is supported.
k. Integration of components for use under common management is supported for more holistic development.

It is to be noted that MIDH Operational Guidelines for cold-chain components are intended to be broad based at a national level, and are agnostic in relation to locality relevant specifics, yet they provide the option to individual entrepreneur to select components that are best suited to their operational needs. State Governments have further assistance mechanisms and State policies to support the strategic needs for their region.

Cost norms

The cost norms are frequently misconstrued to directly reflect the market price of the infrastructure components. Mission officers must allay this perception and advice beneficiaries that the cost norms are a broad-based method for planning government resources. The cost norms of the scheme are applied strategically for setting direction for specific interventions and relates only to the admissible items in a project. The subsidy scheme has sole purpose to incentivise investment in key areas basis policy direction and is not a funding mechanism. In practise, the cost of a project will include non-admissible items like land and other equipment

and items and each project's finances must be fully met through the promoter's share and the credit raised. The subsidy is provided to offset the credit burden, and the support is back ended and directly linked to credit availed. Similarly, the assistance pattern will be observed to differ between general areas and special areas depending on policy direction. The subsidy rate as per cost norms, will not necessarily be in the same ratio to the total project cost.

At no point are the cost norms listed for equipment to be understood as approval of the market prices of component items. These are normative costs for use in a credit linked incentive system and not perceived as an approval or price discovery mechanism. Equipment suppliers establish the commercial rates independently, depending on market competition and technology offering.

Project appraisal Procedure

A Detailed Project Report (DPR) is first submitted to a Nationalised Bank for the sanction of a loan for the project. The banks will observe their independent guidelines for lending to each project. If seeking subsidy, the DPR with proof of Bank loan sanction along with duly filled Datasheets are to be submitted to State Horticulture Mission (SHM) / National Horticulture Board (NHB) offices.

Each State Government follows due process and recommends the Project for implementation. The MIDH Operational Guidelines detail the delegation of powers for project approval - as per the delegation of authority, the projects can be cleared by relevant State level committees. Where required, the project may also be forwarded by the State to the central Project Appraisal Committee (PAC). PAC reviews the appraised projects for compliance with MIDH Operational Guidelines and forwards the applications to the Empowered Monitoring Committee (EMC)/Executive Committee (EC), which are final authority for sanctioning projects for Central Government support (Refer Annexure-III of MIDH Operational Guidelines).

Admissible measures

In Referring to MIDH Operational Guidelines, Annexure V-C1 to C13, Annexure VII-B.1 to B.5 and Appendix II, this document details the admissible items and minimum system standards. For the purpose of these guidelines, $3.4m^3$ (cubic metre) or 120 cubic feet of temperature controlled storage space created shall be considered equivalent to 1 MT (metric ton) of storage capacity, irrespective of the product stored. Similarly, $3.0m^3$ (cubic metre) or 106 cubic feet of temperature controlled space shall be equivalent to 1 MT (metric ton) of transport capacity, irrespective of the product carried. In case of ripening chambers, $11.0m^3$ (cubic metre) shall be considered equivalent to 1 (MT) metric ton of storage capacity.

This document does not override existing standards, codes and guidelines relating to building structures, fire-fighting and safety, machines and equipment, health and pollution as established by State and Central authorities. This document is a guidance on the minimum system standards for effective cold-chain deployment.

General

India's existing cold-chain infrastructure has served famously in case of certain product types. Various crop types and in particular potato, are now available across seasons and across regions. There is scope for scaling up the existing user sector. For many other horticulture crop types, the cold-chain has yet to make a suitable or desired impact. This was largely pending an up-scaling of market demand, which is seen at tipping point now.

Today, imported produce sells readily at rates commensurate to quality, despite incurring all the added costs of domestic logistics, foreign procurement and labour, along with cross oceanic freight costs. These imports increasingly capture a higher share of consumer sales because they reach our shelves readily, in quality and are easily made available to the consumer. From the growth trend of imported fruits and vegetables over the last decade, it is made clear that the domestic consumer is demanding and spending on good quality fresh produce.

The domestic produce reaches from farm to consumer through a multi-layered logistics system, outside the cold-chain, and hence suffers poor handling and from exposure to open uncontrolled environment. This negatively impacts on quality, causes high in-transit losses and the inherent perishability results in a reduced radius of markets that farmers can access into. To increase their share in better paying markets, the domestic produce must reach out to many more locations and integrated chains that connect cross regionally, require developing. Notice is also brought to missing links in this integration. The first missing link is the point of origin, or the modern pack-house for fresh fruits and vegetables. These need to proliferate in farming areas of primary offtake points. The associated temperature controlled transport is the next component of the logistics chain and is seen to be in short supply. Multi-modal operations which includes rail and waterways do not play much role on the domestic front at this moment and can be developed. For safe ripening of fruits intended for fresh consumption, ripening units are needed.

The cold stores in this market linked chain, are intended to primarily serve as cross dock distribution centres on the frontend; these have been built but more are required to close the long haul route. Cold stores for long term bulk storage of specific commodities have developed over the years and while not always part of the integrated cold-chain, some of these also need augmenting. Nevertheless, the aim of these bulk stores is not to deny the market, but to offset episodic production seasons by serving as buffers to the supply chain. Retail units including modern merchandising units will ensure the chain is complete. All of these are included under support programmes of the Central Government.

Each State will have specific infrastructure requirements to develop so as to network not only within their territories, but such that the cold-chain intervention networks across the nation and even onto foreign shores. The development of holistic and integrated supply lines will effectively bring the market to the farmer, and in turn give rural India a choice of buyers to sell to. Cold-chain is the technology intervention that allows farmers to expand their footprint to distant buyers, promoting gainful livelihoods and justifies efforts to increase production.

THE FOLLOWING PAGES INFORM ABOUT EACH COMPONENT PROVIDING A DEFINITION AND DESCRIPTION, FOLLOWED BY REMARKS & RECOMMENDATIONS. A REFERENCE DATA SHEET WITH AN EXPLANATION OF THE INPUTS REQUIRED IS ALSO PROVIDED FOR EACH COMPONENT.

THE APPENDIX-1 TO THIS DOCUMENT CONTAINS BLANK DATA SHEETS FOR EACH INDIVIDUAL COMPONENT THAT ARE TO BE FILLED AND SUBMITTED WITH EACH DPR BY THE PROJECT PROPOSER. THE DATA SHEETS MAY BE AMENDED AS REQUIRED.

INTEGRATED PACK-HOUSE

Component Definition

This component refers to modern integrated pack-house with facilities for conveyer belt system for, sorting and grading, washing, drying and weighing.

Component Description

A modern integrated pack-house unit enables small lot sourcing of horticulture produce, and should be built close to farming area. A maximum admissible cost norm of 50 lakhs per integrated pack-house unit is applicable for each beneficiary. The actual value of the equipment will vary as per design options. The unit capacity of an integrated pack-house is considered at 16 MT per day and is considered for output from 2MT/hour sorting grading line, running for 8 hours a day. The design capacity of each project will be considered pro-rata – for example a 32 MT per day throughput will be equivalent to 2 pack-houses. The included equipment are weighing scales, mechanised facilities like conveyer belt for sorting, grading units and where applicable washing, drying units.

The component "Integrated Pack-house" includes:

1. Receiving area, covered: a covered shaded area for arriving produce to be off-loaded and undergo pre-selection and weighing.
2. Enclosed covered sorting and grading area: a food handling hall with mechanised handling and cleaning equipment.
3. Sorting and Grading conveyors: mechanised roller or belt based system to allow working personnel to selectively pick and choose produce for next activity, capable of handling 16 MT of output per day. Water based conveyor system used for some crops.
4. Washing/Drying equipment: where required, mechanised washing and drying lines.
5. Packaging area: designated area where produce is manually packaged into market lots.
6. Electricity generator: a DG set to produce power for equipment operations. Where alternate energy options (bio-mass based generators, solar powered generators, etc.) are used, add-on technology component (MIDH Appendix II - xv) will apply.

An area of 9 x 18 metres is the indicative enclosed area for each pack-house. Each pack-house appraised under this component should have minimum equipment to facilitate the basic sorting and grading. Additionally washing, drying and weighing equipment can also be installed so that product is readied for packaging. In special cases, such as bulk storage for perishables like apples, sorting grading facility is built adjoining the storage facility to sort storable quality. These pack-house facilities can handle upto 150MT per day. Where the sorting grading line incorporates electronic sorting, the related add-on technology component can be applied.

Remarks / Recommendations

The sorting grading unit would typically have a Feeding line, Conveyors on which the Products are carried on a belt which enable people standing along each side to visually inspect the product, a sizer which would be capable of grading by size many different kinds of fruits and vegetables, but also capable of sizing into different categories simultaneously. Additionally cleaning Units for Washing, Brushing, Disinfection, Straining and Polishing. The total

mechanised machine can do a combination or/and a part of mentioned activities. The total throughput is assessed on a tons per hour basis, and an 8 hour working period is considered as maximum daily output.

This component is a missing link in the overall value chain for horticultural produce and its development is critical to integrated development of supply chains for this sector. When such a facility is targeting to use the cold-chain as a supply channel, they must also apply for the Precooling unit and Cold room (staging) components. The add-on component of packaging line is also supported for such units. With these combinations used, the pack-house is geared to open all market channels including the most valuable cold-chain.

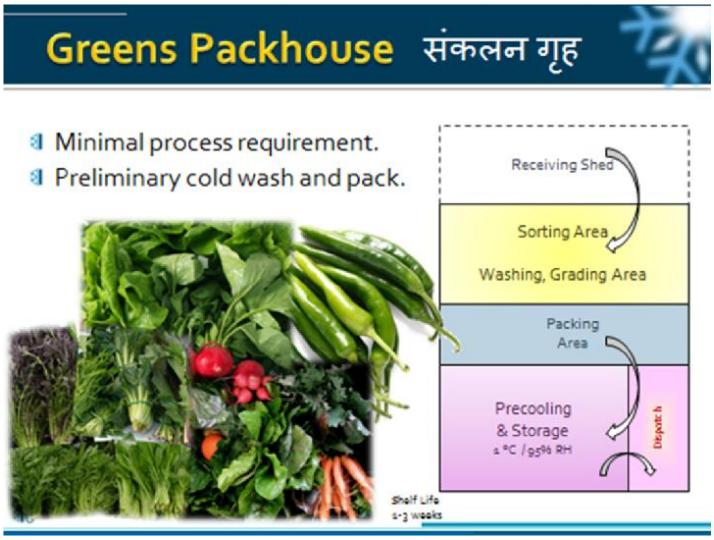
An integrated pack-house unit is used to operate so as to open multiple market channels for produce. Sorting and grading will allow to selectively channelise the following market options:

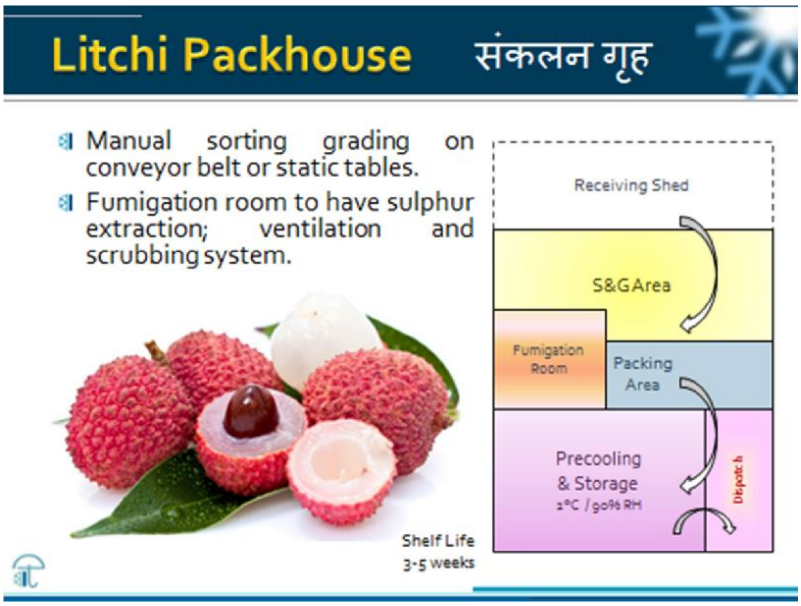
1. Direct to local market channels, packaged or non-packaged.
2. Localised storing of selected produce for off-seasonal supply.
3. Channelize into cold-supply-chain for distant markets or cold stores.
4. Selected produce routed to food processing units.
5. Management of waste by routing to non-food processing.

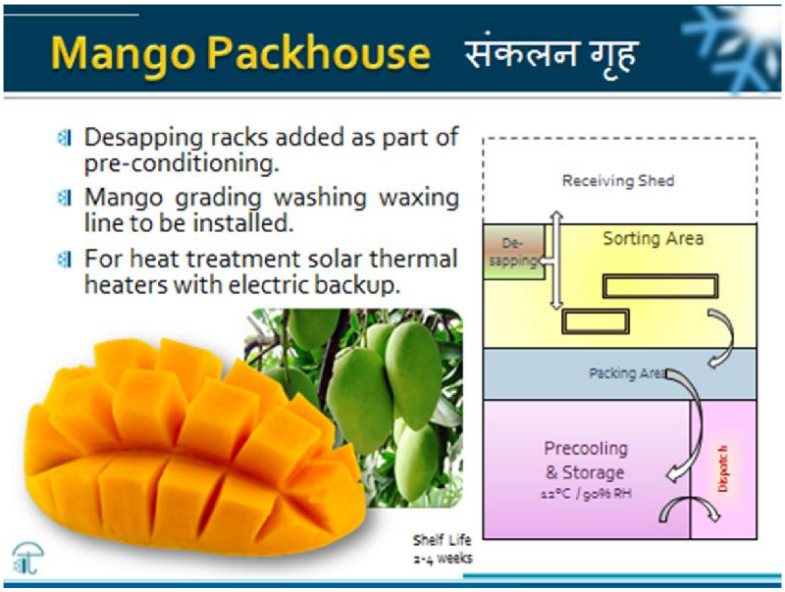
Such Pack-houses are the first step in organised post-harvest management for horticulture and are effectively first mile production units for this sector. Associated pre-cooler with staging cold room should be available in conjunction with pack-house. If not existing, then these two components must also be created. Integrated pack-houses with pre-cooling and dispatch cold rooms will vary in design depending on type of produce to be handled. Optimal designing can enable a pack-house for multiple produce handling. The basic flow of produce in such pack-houses is handling on receiving the harvested goods, preliminary pruning/trimming/de-handing (some of which can happen at farm level), sorting as per market channel and quality assessment, grading as per size and colour, packaging and labelling as first level pre-conditioning, unitising the load to precool the packaged load, transient storage in cold room in preparation for onwards transport.

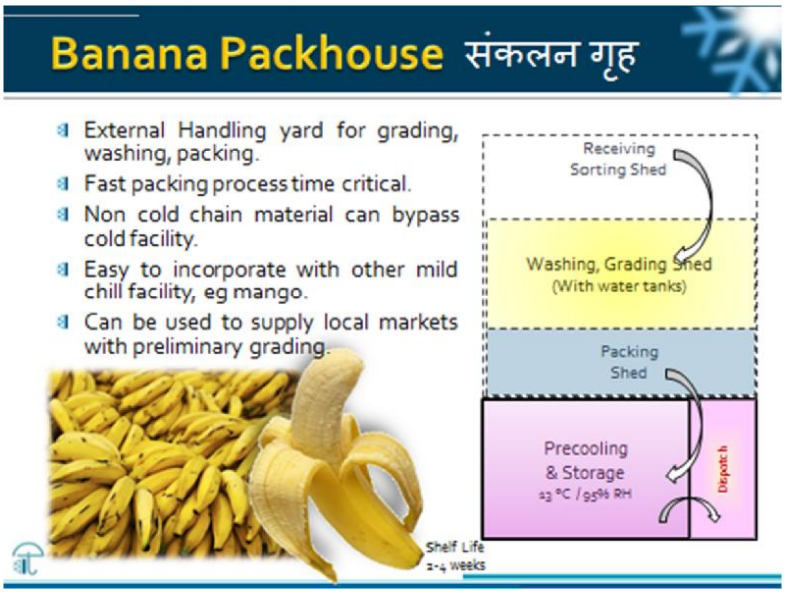
Facility for conveyer belt system depends upon product to be handled. For example in case of mangoes, litchis etc. conveyer belt system is used. In case of Bananas water troughs are used in place of conveyer belt system.

Sample thematic layouts:









Sample layouts – the actual dimensions will depend on final plan layout

Reference Data Sheet

#	Component: Integrated Pack house	Description
1	Pack house Handling capacity	Specify total incoming volume of raw produce in MT/day.
2	Products to be handled	Describe the details of the products planned for value addition.
3	Area of the pack house	Specify the total Plinth area of the construction in m^2.
4	Receiving Area (L x W x H)m	Provide the dimensions of the receiving, weighing and preliminary handling area.
5	Dimension of the building (L x W x H) m	Provide the total covered area of the building.
6	Handling Area (L x W x H)m	External dimensions of the designated sorting, grading, cleaning and packing area.
7	Roof Details	Provide the construction material and specifications of roof.
8	Outer walls and Flooring Details	Description of the outer walls and flooring of enclosed area (food grade materials).
9	Lighting - Internal and External	Type of lighting used (CFL/LED/Normal – total numbers and wattage).
10	Door/ Window Details	Number and Dimensions of openings - doors and windows.
11	Pest control details	Number and details of pest control used (air curtains, other equipment, etc.).
12	Fumigation Details	Specify the details of fumigation if used.
13	De-sapping tables	Specify use of de-sapping tables if used.
14	Mechanised Conveyor system & capacity	Dimensions of conveyor system – belt or roller based, and throughput handling capacity in tons/hour.
15	Washing and Drying machinery (if used)	Specify the details of throughput capacity/motors/pumps/ belts used.
16	Power generating unit	Details of electric generator installed (kVA). If using alternate energy or hybrid systems, provide specifications.
17	Inclusion of Pre-cooling chamber in pack-house	Yes/No
18	Inclusion of staging cold-room in pack-house	Yes/No
19	Layout Drawing	Provide layout drawings of the complete pack house including pre-cooler and staging cold room.

All mandatory rules & regulations (BIS, ISO, IS etc.) relevant to the item must be complied with.

PRE-COOLING UNIT

Component Definition

The component Pre-Cooling Unit refers to a specialised cooling room that rapidly removes field heat from fresh produce after harvest and thereby prepares the cargo for subsequent shipping. Precooling or post-harvest cooling is one of the most critical steps in preparing fruits and vegetables for the extended cold-chain. Pre-cooling unit must have an adjoined staging cold room in all pack houses.

Component Description

A maximum admissible cost norm of Rs.25 lakh/unit is applicable for each beneficiary. The total capacity of a pre-cooler component considered is 18MT per unit, i.e. capable of precooling 3 batch loads of 6 MT per day. A pro-rata cost shall be considered in proportion to other capacities or design options.

The component "Pre-cooling unit" includes:

1. Insulated room: Thermally insulated room, designed to precool 6 MT of fresh produce in temperature controlled conditions and high humidity levels.
2. Pre-cooler unit: Heat exchange coil with high airflow fans designed to maintain very high Relative Humidity levels for batch load of 6MT.
3. Evaporating and Condensing Unit: Air cooled or water cooled condensing unit with refrigeration capacity and associated evaporator unit to pull down the field heat of 6MT of fresh produce in 4 to 6 hrs.
4. Controls: Electronic controller for controlling refrigeration and for temperature and Relative Humidity monitoring.
5. Electricity generator: a DG set to produce power for equipment operations. Where alternate energy options (bio-mass based generators, solar powered generators, etc.) are used, add-on technology component (MIDH Appendix II-xv) will apply.
6. In case of cold storages (type 2) which are designed with high capacity refrigeration to pre-cool and pull down the produce temperature in each storage chamber (i.e. CA enabled cold stores for apples, pears), 1% of the cold storage volumetric capacity can be considered under component of pre-cooler with a maximum capacity of 100MT.

Other kind of precooling systems include the vacuum cooler, hydro-cooler, etc. and these have unique designs and will be considered for appraisal on project basis.

Modern pre-cooler design incorporate equipment and design aspects to sustain high RH levels (upto 98%) and high air flow and static pressure conditions. This allows for maximum penetration of cooling medium for rapid temperature exchange and minimal loss of moisture. Once this energy intensive phase is completed, the produce is shifted into an adjoining cold room in preparation for onward dispatch to cold storages or for direct market access. The pre-cooler is then reused for the next harvest batch. Approximately 3 complete cooling cycles of 6 hours each can be output from a forced air pre-cooler every 24 hours. In example of apple stores, the precooling is effected inside the cold store chamber over and refrigeration capacity is suitably designed for this function.

Mobile pre-cooling units are also a subsidy component under these guidelines. These may be apt for farms with internal roads and direct linkage with a post precooling facility such as cold storage or food processing factory.

Recommendations

A Pre-cooling unit is the heart of a modern pack-house where the temperature controlled phase of the cold-chain is commenced. Once the produce is selected and graded into packaged condition, it undergoes this part of temperature conditioning.

Post-harvest cooling is undertaken as it retards the natural senescence processes. Prompt pre-cooling conserves the weight and extends storage life of fresh horticulture.

Proper postharvest cooling will:

- Suppress respiratory activity and enzymatic degradation (softening).
- Slow or inhibit water loss (wilting).
- Slow or inhibit the growth of decay-producing microorganisms (moulds and bacteria).
- Reduce the production of ethylene or minimize the commodity's reaction to ethylene.

In addition to protecting quality, postharvest cooling enhances marketing flexibility by making it possible to market fruits, vegetables, and flowers at more optimum times.

Field heat removal method choices depend on several factors, including:

- Temperature of commodity when harvested.
- Nature of the commodity; type of product (e.g., leafy greens, flowers, fruit) respiration rate(s), cooling requirements, lowest safe temperature, tolerance of exposure to water. (Typically, with the exception of onions, garlic, zucchini, summer squash, hard squash, most fresh fruit and basil, all other crops can be washed by either spraying with water or dunking to remove soil and/or reduce “field heat”).
- Product packaging requirements; Box, bin, or bag; because packaging materials and design configurations affect method and rate of cooling.
- Product flow capacity; Volume of commodities which must be handled per unit of time will determine the appropriateness of cooling methods and systems.
- Mix of commodities; Compatibility depends on their nature with regard to sensitivity to odours and volatiles, such as ethylene.

Common Cooling Systems

Room cooling: Produce is placed in an insulated room equipped with refrigeration units. This method can be used with most commodities, but is slow compared with other options. A room used only to store previously cooled produce requires a relatively small refrigeration unit. However, if it is used to cool down the produce, a much larger unit is needed. The goods should be stacked so that cold air can move around them, and can move through them.

Forced-air cooling: Fans are used in conjunction with a cooling room to pull cool air through packages of produce. Although the cooling rate depends on the air temperature and the rate of air flow, this method is usually 75–90 percent faster than room cooling.

Fans should be equipped with a thermostat that automatically shuts them off as soon as the desired product temperature is reached. To avoid over-cooling and dehydration of produce, do not operate forced-air fans after the produce has been cooled to its optimum temperature.

Hydro-cooling: Dumping produce into cold water, or running cold water over produce, is an efficient way to remove heat, and can serve as a means of cleaning at the same time. In addition, hydro-cooling reduces water loss and wilting. Use of a disinfectant in the water is recommended to reduce the spread of diseases. Hydro-cooling is not appropriate for berries, potatoes to be stored, sweet potatoes, bulb onions, garlic, or other commodities that cannot tolerate wetting.

Water removes heat about five times faster than air, but is less energy-efficient. Well water is a good option, as it usually comes out of the ground with temperatures in the 10-15°C range. If hydro-cooling water is recirculated, it should be chlorinated to minimize disease problems.

Icing: Icing is particularly effective on dense products and palletized packages that are difficult to cool with forced air. In top icing, crushed ice is added to the container over the top of the produce by hand or machine. In case of liquid icing, slurry of water and ice is injected into packaged produce through vents or handholds.

Icing methods work well with high-respiration commodities such as sweet corn and broccoli. One Kg of ice will cool about three Kgs of produce from 30°C down to 4°C.

Vacuum cooling: Produce is enclosed in a chamber in which a vacuum is created. As the vacuum pressure increases, water within the plant evaporates and removes heat from the tissues. This system works best for leafy crops, such as lettuce, which have a high surface-to-volume ratio. To reduce water loss, water is sometimes sprayed on the produce prior to placing it in the chamber.

This process is called hydro vac cooling. This is the most cost-effective and rapid method of cooling. The primary drawback to this is the cost of the vacuum chamber system.

Reference Data Sheet

#	Component: Pre-cooling unit	Description
1	Produce to be pre-cooled	Name the produce types to be handled.
2	Unit Package load	Specify packaging used- Pallet, Boxes, others.
3	Pre-cooler volumetric capacity	Provide pre-cooler physical volume in cubic meters. Specify the (L x B x H) of pre-cooling unit in metres
4	Cooling System used	Describe type of precooling - forced-air cooling, hydro-cooling / icing / vacuum cooling / room cooling.
5	Temperature and RH levels.	Temperature in degree Celsius and relative humidity in % designed for.
6	Pull down time (batch time)	Time duration per batch to bring the initial product temperature to the storage temperature.
7	No of batches planned in a day	List the number of batches planned per day.
8	Refrigeration Load	Estimated refrigeration load in kW.
9	Insulating material used	Type of insulating material, thickness and 'U Value'.
10	Evaporator/Chiller make	Maker name and model of the evaporator/chiller unit.
11	Air flow & static pressure.	Pre-cooler air flow in cubic meter per hour and static pressure in kPa.
12	No of fans	Specify the quantity of evaporator fans and connected motor power.
13	Water pump capacity	Specify the water flow in m^3
14	Motor rating	Specify the pump motor capacity in kW.
15	Make of condensing unit	Maker name and model of condensing unit.
16	Refrigeration of condensing	Specify the capacity of condensing unit in kW.

#	Component: Pre-cooling unit	Description
	Unit	
17	Condensing unit type	Specify the whether it is air cooled or water cooled.
18	Door details	Dimensions, insulation material and thickness of the door.
19	Controls Used	Specify the electronic controller for room temperature and relative humidity monitoring & control.
20	Refrigerant used	Technical name of refrigerant.
21	Total connected Power	Specify the total connected power in kW.
22	Power generating unit	Details of electric generator used (kVA). Capacity must be sufficient for operating pre-cooler and staging cold room.
23	Layout Drawing	Provide layout drawings of the pre-cooling unit including pack-house and staging cold room.

All mandatory rules & regulations (BIS, ISO, IS etc.) relevant to the item must be complied with.

COLD ROOM (Staging)

Component Definition

This component is an insulated and refrigerated chamber which is a necessary combination for Pre-Cooling Unit and serves as a transient storage, while allowing the pre-cooler to be utilised for next batch load of incoming produce.

Component Description

A maximum admissible cost norm of Rs.15 lakh/unit for a storage capacity of 30 MT is applicable for each beneficiary. A pro-rata cost shall be considered in proportion to other capacities or design options.

The component "Cold room (staging)" includes:

1. An insulated room of 100m^3 volume - capacity to store 30MT
2. Associated refrigeration equipment.
3. Staging area – adjoining enclosed area to load vehicle for dispatch.

The component has been kept separate but must be appraised only when attached to a pre-cooling unit. The beneficiary must be advised that the cold room (staging) necessitates the following:

1. Other preconditioning facility (integrated pack-house).
2. An appended Pre-cooler unit.
3. An ante-room for staging.

The design specifications of such cold rooms are similar to a cold store, with the refrigeration design to suit humidity and temperature ranges for horticulture produce. Where pre-coolers are built appended to an existing cold store, the cold store itself serves this purpose.

Recommendations

The staging cold room is a small temperature controlled room appended to a pre-cooler so as to allow temporary holding prior to staging for onwards dispatch (on to a reefer truck). A Pre-cooling unit along with such a Cold room is necessary to enable temperature controlled post-harvest handling for all high perishable crops.

In view of the fact that existing cold stores at farm-gate may need to select only individual component items to fulfil the operational need to serve as pack-houses, the integrated pack-house / pre-cooler / staging cold room items have been kept as individual components so that such existing cold stores can select to suit requirements. For new installations, it is recommended that all three components be created, as applicable.

These first three series of components are created at production areas (farm level) and will close a critical missing link in cold-chain for the horticulture sector. Without this combination of components, there is no scope for domestically grown produce to safely access our existing cold stores. The integrated pack-house, pre-cooler and cold room (staging) are effectively points of origin of the fresh produce cold-chain.

The next step in the cold-chain is transport connectivity linked to cold storages that serve as mid-term buffers and transient term storage, prior to retail level distribution. Cold storages can also be used as long term farm gate storage to bide seasonal shortfall, but these can serve in case of a few select produce only. Other farm gate storage is to serve for short weekly swings for the market local to the farms.

Reference Data Sheet

#	Component: Staging Cold Room	Description
1	Products to be stored	Name the produce types to be precooled and stored.
2	Temperature and RH levels.	Temperature in degree Celsius and relative humidity in % designed for.
3	Staging cold room dimension	Dimensions of the insulated cold room (L x B x H) in mtrs.
4	Insulation used	Type of insulating material and thickness along with 'U Value'.
5	Refrigeration Load	Total refrigeration load in kW.
6	Evaporator/Air-cooler make	Maker name and model of the evaporator/air-cooler unit.
7	Evaporator construction	Details for heat exchange coil, fans.
8	Air flow	Air cooler air flow in cubic meter per hour.
9	No of fans	Quantity of evaporator fans and connected motor power.
10	Make of condensing unit	Maker name and model of condenser unit.
11	Refrigeration of condensing Unit	Refrigeration Capacity of condensing unit in kW.
12	Door details	Provide the dimensions, insulation material and thickness of the door.
13	Controls Used	List the electronic controller for room temperature and relative humidity monitoring & control.
14	Refrigerant used	Technical name of refrigerant.
15	Total connected Power	Total electric Load in kW.
16	Layout Drawing	Provide layout drawings of the staging cold room unit including pre-cooler and pack-house.

All mandatory rules & regulations (BIS, ISO, IS etc.) relevant to the item must be complied with.

COLD STORAGE UNITS

Multi Temperature and Multi-product cold store

This component refers to temperature controlled storages designed to for post-harvest storage of horticulture produce. Two types of cold stores are categorised.

a. Type 1: designed with chamber sizes of more than >250 MT, each chamber under single temperature control & designed for single product storage.
b. Type 2: designed with chamber size of <250 MT, with more than 6 chambers, capable of multiple temperature control so as to suit multiple product storage.

Component Description

Under MIDH norms a beneficiary may apply for construction and expansion of cold storages up-to 10000 MT storage capacity. State Horticulture Missions shall accept projects of capacity 5000MT and below and National Horticulture Board shall accept projects of capacity larger than 5000MT. The cost norms vary depending on scale of storage capacity.

For the purpose of these guidelines, $3.4m^3$ (cubic metre) or 120 cubic feet of temperature controlled storage space created shall be equivalent to 1 MT (metric ton) of storage capacity, irrespective of the product stored.

Cold storage type 1: Are cold stores with large chambers (>250MT each), each designed for single product storage. These types of stores are designed for bulk long term storage (potato, spices, pulses, etc.). This storage has handling system for unpackaged or soft packaged produce, or produce stored in bags or bins (non-retail packaging). Produce on exiting such stores have to undergo bulk shipping to processing plants or subsequent packaging process for making consumer retail packages. These are seen to be primarily brick & mortar structures with multi-layered fixed or mezzanine floors. They incorporate small handling area or open sheds designed for one time seasonal loading (during harvest season), and for smaller volume off-loading to serve specific buyer demand. They must incorporate air monitoring and ventilation mechanism for controlled air replenishment, enabling them to counter produce induced modified atmospheric parameters inside the storage chambers.

Cold Storage unit Type 2: Are cold stores with more than 6 chambers, each chamber of less than 250 MT in capacity, with each chamber having independent room based controls and refrigeration so as to make them capable of serving at differing temperature zones, suitable for storing multiple temperature type commodities. Each chamber is designed for unitised load handling with basic material handling equipment and construction is normally seen to be of modern PEB type with composite panels. These types of stores are primarily designed for short term storage, used as distribution hubs for packaged and ready to retail produce, as front ends market links as part of the cold-chain. Such stores will have large temperature controlled ante-rooms (non-storage area) designed to handle underroof traffic for multiple receipt and dispatch operations and will additionally have basic material handling equipment such as pallet lifts, fork lifts, etc. This type of cold store construction is also used for modern farm-gate storage of perishables and where applicable can also apply for certain add-on technologies to make some chambers capable of controlled atmosphere (CA enabled) storage.

The extant guidelines, standards and data sheets, as published by NHB on behalf of Department of Agriculture and Cooperation, for cold storage projects have been incorporated.

The applicable support to both types of cold stores is as follows:

Credit Linked back-ended

Subsidy 35% of project cost (general areas); 50% in Hilly and scheduled areas	**Cold Store** Type 1: Basic, large chambers (of >250 MT each) for single product storage / temperature zone.	₹ 8000/MT for max capacity 5000MT (*NHM*) ₹ 7600/ MT for capacity 5001 to 6500 MT (*NHB*) ₹ 7200/MT for capacity 6501 to 8000 MT (*NHB*) ₹ 6800/MT for capacity 8001 to 10000 MT (*NHB*)

Credit Linked back-ended

Subsidy 35% of project cost (general areas); 50% in Hilly and scheduled areas	**Cold Store** Type 2: multi-product use, >6 chambers (of <250 MT each) for various product types with basic material handling equipment	₹ 10000/MT for max capacity 5000MT (*NHM*) ₹ 9500/ MT for capacity 5001 to 6500 MT (*NHB*) ₹ 9000/MT for capacity 6501 to 8000 MT (*NHB*) ₹ 8500/MT for capacity 8001 to 10000 MT (*NHB*)

Remarks / Recommendations

These two cold storage unit types are aligned with the two basic storage needs. The first primarily for long term bulk storage, usually not directly linked with consumers, storing in bags, bulk or lots which are not retail ready packages, utilised to span seasons. The majority of such cold storages apply themselves to storing potatoes, spices, pulses, etc. These cold stores are able to maximise actual storage capacity in the design of the facility as operational requirement does not require a large handling space.

The cold store type 1 is normally constructed in areas close to producing areas (farm-gate) to facilitate quick access to farmers. A brick and mortar structure with mezzanine flooring is seen to be the operator's choice for these structures. The mezzanine floors are accessed through

connecting staircases and these cold stores may dedicate a room or open platform for product handling.

For designing a cold storage, produce storage conditions must be defined in terms of critical conditions of temperature, relative humidity, presence of CO_2, ethylene, air circulation, light, etc. In absence of research data for Indian conditions, it is recommended to adopt well established conditions as per information provided by National Horticulture Board and CIPHET (Central Institution for Post-harvest and Engineering Technology).

The cold store type 2 are normally constructed close to consumption centres and operational needs require planning for large temperature controlled ante-rooms which minimises the cold storage capacity (ante-rooms are not admeasured as storage space). These cold stores are typically pre-engineered building structures and provide internal vehicular handling and parking to allow for frequent loading and dispatch operations. Multiple commodities are handled at such facilities, including nor-horticulture products. These facilities are also suited for logistics hubs such as ports and railheads. Modern storage establishments designed for high accuracy temperature and atmosphere parameter controls would also fall under this type.

Depending on the specific products and design capability, both types of cold storage units can apply for add-on technology components to suit their operations and business models.

Small capacity cold stores of less than 500 MT would normally incur a higher than existing pro-rata cost per ton as applicable. Since such cold stores would normally suit small entrepreneurs / farmer group's need, it is recommended that such projects be assessed on a case to case basis, for techno-commercial viability and appraisal.

Reference Data Sheet for Cold Storage Type 1:

i) Cold Store Chamber Sizing and Capacity

- Please enclose Sketch with Plan layout and sections showing the storage chamber

Details	Chamber 1	Chamber 2	Chamber 3	Chamber 4	Chamber 5
Temp. Zone & Relative Humidity conditions	**0 to 2** ^{0}C 90-95% RH	**0 to 2** ^{0}C 95 – 100% RH	**0 to 2** ^{0}C 65 – 75% RH	**0 to 2** ^{0}C 90 – 95% RH	**0 to 2** ^{0}C 85 – 90% RH
Name of Produce	Potato	Seed			
Number of platform per chamber	4	4			
Type of platform used	Wood grating	Steel grating			
Dimensions of CS chambers in each group (L x W x H) m	23 x 20 x 11				
Storage Capacity of each chamber in tons	1488 MT				
Storage unit used (Bags, crates, carton, bulk heap, etc.)	Bags	Bags	Bags		
Total number of storage unit	29750	25000			
Weight per storage unit	50 kg	50 kg			
Heat load per chamber (kW)					
Any other information	Describe other information like bulk heap storage and number of cooling tunnels, total cooling load per chamber.				

Figures / data are as examples for user
Each chamber is a common temperature zone

ii) Handling Area

Details	Dimensions	Temp ^{O}C
Describe Handling, receiving area (covered, open shed)	Handling Area Dimensions (L x W x H)m	Expected temperature in handling area.
Describe Loading / Unloading platform	Dimensions (L x W x H) m of the loading and unloading platforms.	Expected temperature in loading platform

Loading and handling area may be common in some storage designs

iii) Facility covered Areas

Cold Storage Area and height	Total floor area in m^2 (sum of all storage chambers internal area.)
Machine room area/ height	Dimensions in metres
Generator room area / height	-- " --
Admin Block area / height	-- " --

iv) Building & Construction Details

Type of building construction	Specify if building is with RCC civil construction or with pre-engineered structural steel construction with insulated panels.
External walls/Internal walls /Partition walls of cold chambers	Specify whether the walls are constructed with civil building with insulation slabs fixed in the walls or composite panels used.
Specification of Roof/Ceiling	Specify ceiling is construction – civil work with insulation slabs fixed or composite panels used.
Lighting fixtures in cold chambers	Specify use of special lights and fixtures with weather protection.
Specification in handling/External compound areas	Materials used in construction of handling, external compound area.
Others	Describe if chambers are divided into vertical temperature zones (RCC floors, insulated vertically)

v) Insulation and Vapour Barrier

Type of Insulation	Wall		Ceiling / Roof	Floor
	External	Internal		
Specification of insulation material	Describe the type of material used for insulation of walls/ceiling and partition and floor.			
Specification of composite panels	Describe the type of composite insulated panels used for insulation			
Relevant IS Code	State applicable IS Codes applicable for the specification of the below characteristics of the insulation material used.			
Thermal Conductivity (k-value) at +10°C (mean temperature)	Indicate the heat transfer ability of the product in W/m.K at 10 °C mean temperature			
U-value	Provide the U-value of the insulation.			
Thermal diffusivity (m^2/ sec)	Indicate heat transfer relative to the storage of thermal energy.			
Vapour barrier specification	Describe type of material and thickness of the vapour barrier used.			
Total Insulation thickness	Indicate total insulation thickness and number of layers.			
Specification on Cladding	Describe external finish / cladding material			
Locking/Fixing & Sealing System in case of Metal Skin composite Panels	Cam lock system for discontinuous panels / Tongue and Groove joints for continuous composite panels (Single or double).			

vi) Cold Store Doors & Air / Strip barriers or curtains

Description	Details
No. of doors per chamber.	Quantity of number of insulated doors.
Type hinged / sliding/ Rolling	Type of Door movement and Operation.
Size of door opening	Internal clear opening dimensions (W x H).
Insulation Material	Type of insulation along with its 'U-value'.
Thickness of Insulation	Provide the thickness of insulation in millimetre.
Type of skin	Galvanised/Stainless steel/GRP
Provision of Strip curtains/Air curtains – nos.	Strip or Air curtains used – number and dimension (W x H)

Internal Emergency Door release	Internal release mechanism for emergency opening even when locked from outside or Push button type alarm located inside the cold chambers near the door.

vii) Heat Load Estimation Inputs

Product Storage condition	List Product wise storage temperature in ^{o}C, relative humidity required in %, Air circulation rate in CMH.
Loading Period	Total no. of days/weeks for completion of product loading in a season.
Maximum storage period	Product wise maximum storage period planned in weeks/months.
Product loading temperature	Product loading temperature during the peak season in ^{0}C.
Loading rate per day	Daily throughput in metric tons which enters into the cold storage.
Pull down period	Time in hours to bring initial product temperature to storage temperature.
Estimated Daily unloading rate from each cold chamber	Provide the unloading rate in MT per day.
Ante Room cum staging area conditions	List Temperature to be maintained in °C
CO_2 Concentration Control	List recommended range of $C0_2$ concentration in PPM.
Fresh air changes	Number of air changes per day considered
Brief Description of Fresh Air Ventilation system	Capacity of Fresh Air Fans for Replenishment of fresh air into each of the cold chambers.
Explain heat recovery system, if used	Description of heat recovery system, recommended efficacy, type of system, cross heat exchange used.

viii) Heat Load Calculation of Cooling System – Summary

Ambient Conditions Dry Bulb temperature (Summer)	Peak conditions based on summer

Building dimensions: Total Capacity of the storage: Number of the chambers :	Provide the Dimensions of the building, total capacity of storage and number of chambers.

Note: Please attach additional heat load estimation for, as applicable depending upon, different group of commodity planned.

Refrigeration Load		During Loading (kW)	During Holding (kW)
Transmission Load (kW)		Heat transferred through walls , ceiling and floor due to difference in outside and inside temperature	
Product Load (kW)		Heat transferred from the product due to difference in product temperature at the time of loading and storage room temperature.	
Internal Load (kW)	Lighting load	Internal heat generated due to lights in the cold room.	
	Occupancy load	Heat transferred due to human activity within the cold room.	
Infiltration Load (kW)		Heat transferred from outside air during door opening.	
Ventilation/ Fresh Air (kW) Refurbishment Load		Heat transferred d fresh air replenishment	
Equipment Load – Evap. Fan motors, MHE etc. (kW)		Total Heat transferred from various above sources in a day.	

Compressor Operation Hours/Day	Pull Down Period	Indicates compressor running hrs. during pull down time of the product in a day
	Holding period	Indicates compressor running hrs after the product reaches the room storage temperature.
	Defrosting Period	Duration of Defrosting in a day.

Total Refrigeration Description(kWh)	Peak Period(kWh)	Holding Period(kWh)

Cooling System Design Detail

ix) Cooling System Configuration: Mechanical Refrigeration

Type of Refrigerant	Provide the technical name of the refrigerant.
Total refrigeration system capacity	Provide the total refrigeration capacity in kW.
Type of System	Direct Expansion/ Gravity Feed/ Overfeed/ Secondary pump.
Type of compressor	Reciprocating/Screw/Scroll.
Type of capacity control	Step less/ step in / Auto unloading of cylinders.
Specify Unloading steps in percentage	Screw Compressor from 10 to 100% Reciprocating from 25 to 100%.
Type of condenser	Atmospheric/ Evaporative/water cooled/Air cooled.
Cooling Towers (if applicable)	Natural draft/ Induced Draft.
Type of Evaporators/ Air cooler	Ceiling or Floor mounted - Induced draft/ Forced Draft / Dual discharge.
Type of defrosting	Air/ Water / Electric/ Hot gas.
Humidification System & Control	Describe the method of humidification and controls used. If using dehumidifier explain here.

Refrigeration Equipment Details

x) Compressor/ Rack Detail

Compressor/ Racks Type, Make & Model	Qty.	Comp. RPM	Operating Parameters SST. / Cond. Temp (^oC)	Refrigeration Capacity (kW)	Power Consumption (kW)	Total connected Motor (kW)	Remarks Working /Standby
					Full load: Part load:		

xi) Condenser Details

Condenser Type, Make & Model	Qty.	Operating Parameters Condensing Temp.(CT) WBT, water in/out temp(^oC)	Condenser Heat Rejection Capacity (kW)	Electric Fan /Pump Motor Rating (kW)	Total Electric Power (kW)	Remarks Working /Standby

xii) Cooling Tower Details (if applicable)

Cooling Tower Type, Make & Model	Qty	Operating Parameters DB & WB Water Temp, in/out (^oC)	Cooling Tower Capacity (kW)	Fan & Pump Capacity (CMH/LPS) & Motor (kW)	Total Electric Power (kW)	Remarks Working /Standby

xiii) Pressure Vessels

Description	**Type Horizontal Vertical**	**Refrigerant**	**Operating Temp & Pressure**	**Construction Shell, Dish Ends & Nozzles**	**Total Refrigeration load**	**Holding Volume**
Low Pressure						
High Pressure						

Note: The design and testing of the pressure vessel should comply with ASME Sec VIII Div 1.

xiv) Evaporators /Air Cooling Units (ACU)

ACU Type, Make & Model	Nos.	Operating Parameters Evap. (SST) & TD* (^{0}C)	Cooling Capacity (kW)	Air Flow (CMH) & Face Velocity (m/s)	Material of Coil Tubes & Fins	Fin pitch (mm)	Total Fan Electric Power (kW)

*TD – Temperature difference between Evap. (SST) ^{0}C & Return Air (at coil inlet).

Note: Please attach Detailed Technical Performance Data Sheets of each equipment namely Compressors, Condensers, Cooling Towers, Air Cooling Units giving General Layout and Dimensions duly Certified by the respective equipment manufacturers with reference to the Relevant Codes & Standards.

xv) Electrical Installation:

Total Connected load	Provide the total connected electrical power in kW.
Estimated power requirement at Peak Load Period	Provide the maximum power consumed during peak demand in kW.
Estimated power requirement at Holding Load Period	List the power consumed during holding period in kW.
Estimated power requirement at Lean Load Period	List the power consumed during lean periods in kW.
Capacity of Transformer	Provide the rated capacity of the transformer in kVA.
Size of Capacitor	Provide the Size of capacitor bank for power factor correction & their operation.
Make & Capacity of standby D.G. Sets	Provide the make and rated Capacity of the Generator in kVA.

xvi) Material Handling procedure

Procedure	Brief Description
Material Handling Procedures & Equipment	Describe the details of product movement inside the cold storage and equipment used.
Capacity of mechanised belt conveyor if any- Rating of motor	Electric motor capacity in kW connected for lifts / hoists / conveyors etc.
Any other device please specify	

Attach a Plan & Layout of the proposed Cold Store unit approved by a Registered Architect.

xvii) Safety Provisions

Include Machine room ventilation system for self-containing

Fire Fighting equipment installed as per Fire safety standards of State Fire Department	Yes / No
	All Fire -fighting equipment complied as per state Fire-fighting department
Handling measures for Refrigerants & Leaks installed	Specify the sensor types and alarm system used, if any
Safety devices – LP/HP cut outs, safety valves, shut off valves etc. installed	
Emergency lighting in Cold chambers & other areas installed	
Lightening arrestors installed	
Any other safety provisions (describe)	

xviii) Energy Saving Equipment & Measures

Details of Energy Saving devices	Brief Description and Savings
Light Fixtures	Type of light fixtures-CFL/LED.
Natural Lighting for general areas	Specify the provision for natural lighting is included.
VFD / Electronic Technology for fans / compressors	Control of fan motors speed using variable frequency drives or by electronic technology in 2 steps fan for evaporators.
Refrigerant Controls and Automation	Automation controls used to save energy for optimizing the performance of the refrigeration system.
Air Purger	List the type and operation of air purger.
Power Factor Controller	Measure of efficient use of electrical power in the connected system.
Energy recovery	Provide use of energy recovery for ventilation system.
PLC Control & Data Acquisition	Automation for monitoring and control of the parameters and Refrigeration plant.
Any other Components	Describe the monitoring and control used such as $C0_2$ scrubbers, odor control, ozonisers, ethylene scrubber etc.

xix) Estimated Performance Parameters of Proposed Cold Store

Parameters	Peak Period	Holding Period
Coefficient Of Performance (COP) of the Cold Store Unit	COP of the cold storage during peak and holding periods.	
Power Consumption (kWh/Day)	Power consumption during peak and holding period.	
Prevailing Electricity costs	Provide prevailing electricity costs in Rs/kWh.	

xx) Brief description of any other technologies or infrastructure used

Reefer trucks operated (if any)	
Specialised packaging lines(if any)	
PLC Automation(if any)	
Dock Levellers systems(if any)	
Alternate energy options(if any)	
Modern Pack-house(if any)	
Others	

Append details in separate data sheets for 'add-on components' if also applying for these components.

All mandatory rules & regulations (BIS, ISO, IS etc.) relevant to the item must be complied with.

Reference Data Sheet for Cold Storage Type 2:

i) Commodity Storage Requirements

Description	Details
Type of Commodities/ Produce	Provide name of the produce types to be stored
Total number of Chambers	

ii) Chamber Sizing and Information

- Please enclose Sketch with Plan layout and sections showing the storage chamber

Details	Chambers Group 1	Chambers Group 2	Chambers Group 3	Chambers Group 4	Chambers Group 5
Storage Condition Temp. & Relative Humidity	**0 to 2** ^{O}C 90 – 95% RH	**0 to 2** ^{O}C 95 – 100% RH	**0 to 2** ^{O}C 65 – 75% RH	**4 to 5** ^{O}C 90 – 95% RH	**10 to12** ^{O}C 85 – 90% RH
Product types					
Number of chambers per group					
Dimensions of chambers in each group (L x W x H)m					
Storage Capacity of Each chamber group (cubic metres)					
Storage units (Pallets, bulk bins, cartons, etc.)	Pallets	Bins	Bins	Pallets	
Stacking system used	Nil	Nil	Overstack bin	Racking	
Total Heat Load calculated per chamber group (kW)					
Total Refrigeration capacity per chamber group (kW)					

Figures / data are as examples for user
Each chamber is a common temperature zone

iii) Enclosed Ante Room & Handling Area

Details	Information	Temp ^{O}C
Ante room/Handling Area (L x W x H)m	Refrigeration kW Load	Temperature maintained in °C in ante room and handling area.
Refrigeration Load	Provide the refrigeration load in kW.	
Number of Access Doors	List number and dimension of main doors to ante room enclosure.	
Dock Leveller system	Provide the details of protected loading unloading platforms if used.	

iv) Facility Covered Areas

Cold Storage Area and height	Total floor area in m^2 (sum of all storage chambers internal area.)
Ante room area	Total floor area in m^2 of ante room (handling area).
Receiving room area and height	
Machine room area and height	
Generator room area	
Admin Block area and height	

v) Building & Construction Details

Type of building construction (load bearing construction)	Specify whether building is with RCC civil construction or pre-engineered structural steel construction with insulated panels.
External walls/Internal walls/Partition walls of cold chambers	Specify whether the walls are constructed with civil works with insulation slabs fixed in the walls or pre-insulated composite panels used.
Roof/Ceiling construction	Describe external roof construction and installation method of ceiling insulation.
Lighting fixtures in cold chambers	List use of special lights and fixtures with weather protection.

External/compound areas	Describe construction of external and compound areas including parking area provided.
Others	Describe if chamber are divided into vertical temperature zones (RCC floors, insulated vertically or common.)

vi) Insulation and Vapour Barrier

Type of Insulation	Wall	Ceiling / Roof	Floor
Specification of insulation material	Describe the type of material used for insulation of walls/ceiling, partition and floor.		
Specification of composite panels	Describe the type of composite insulated panels used for insulation of walls and ceilings.		
Relevant IS Code	State applicable IS Codes applicable for the specification of the below characteristics of the insulation material used.		
Thermal Conductivity (k-value) at +10°C (mean temperature)	Indicate the heat transfer ability of the product in W/m.K at 10 °C mean temperature		
U-value	Provide the U-value of the insulation		
Thermal diffusivity (m^2/sec)	Indicate the heat transfer ability relative to the storage of thermal energy.		
Vapour barrier specification	Describe the type of material and the thickness of the vapour barrier used.		
Specification on Cladding	Describe external finish / cladding material if any.		
Locking/Fixing & Sealing System in case of Metal Skin composite Panels	Cam lock system for discontinuous panels / Tongue and Groove joints for continuous composite panels (Single or double).		

vii) Storage Chamber insulation & details:

Chamber number	Ceiling thickness (mm)	External wall thickness(mm)	Internal wall thickness(mm)	Floor insulation thickness(mm)	Internal Dimensions (L x B x H) m
1	150 mm	150 mm	80 mm	100 mm	
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					

Total volume of all chambers (cubic metres)	
Total Transmission load of chambers (kW)	

viii) Cold Store Doors & Air/Strip barrier or curtain

Chamber number	Number of Doors	Door Opening (w x h) m	Thickness(mm) & 'U-value'	Strip curtain or air curtain	Opens to (ante-room or outside)
1	1	2.7 x 4.0	100 mm, 0.4	Strip	Ante-room
2					
3					
4					
5					

Figures/data are as example for user

ix) Heat Load Estimation Inputs

Product Storage condition	List storage temperature in ^{o}C, relative humidity required in %, Air circulation rate in CMH.
Daily Door Opening	Estimated number of times and period doors opened for daily operations.
Estimated mass of products to be loaded and unloaded daily	Provide the rate in MT per day. Assume that product is within 5^{o} C of storage temperature.
Ante Room area conditions	Temperature to be maintained in ^{o}C.
Special Provisions	Describe other conditions maintained for improving the quality of the stored products (humidity, CO_2 level, CA system, etc.)

x) Fresh Air / Ventilation System

Fresh air changes	Provide number of air changes per day considered in a cold room.
Brief Description of Fresh Air Ventilation system	Capacity of Fresh Air Fans for Replenishment of fresh air into each of the cold chambers.
CO_2 Concentration Control Range	Recommended range of $C0_2$ concentration maintained in PPM.
Monitoring & Control Instrument	Describe the monitoring and control instrument used.
Explain heat recovery system, if used.	Description of heat recovery system, recommended efficacy, type of system, cross heat exchange, if used.

xi) Heat Load Calculation of Cooling System – Summary

Ambient Conditions Dry Bulb temperature (Summer)	Peak conditions based on summer

Building dimensions: Total Capacity of the storage: Number of the chambers :	Specify the dimensions of the building, total capacity of storage and number of chambers.

Note: Please attach additional heat load estimation for, as applicable depending upon, different group of commodity planned.

Refrigeration Peak Load in kW(for storage chambers)		
Transmission Load (kW)		Heat transferred through walls , ceiling and floor due to difference in outside and inside temperature
Product Load (kW)		Heat transferred from the product due to difference in product incoming temperature and storage room temperature.
Internal Load (kW)	Lighting load	Internal heat generated due to lights in the cold room.
	Occupancy load	Heat transferred due to human activity within the cold room.
Infiltration Load (kW)		Heat transferred from outside air during door opening (use ante-room temperature when opening into enclosed ante-room.)
Ventilation/ Fresh Air (kW) Refurbishment Load		Heat transferred through fresh air entering the cold room.
Equipment Load – Evap. Fan motors, MHE etc. (kW)		Total Heat transferred from various above sources in a day
Total Load for Ante-room		Consider similar calculations with outside ambient.

Compressor Operation Hours/Day	Pull Down Period	Indicates compressor running hrs. during pull down time of the product in a day
	Holding period	Indicates compressor running hrs after the product reached the room storage temperature.
	Defrosting Period	Duration of Defrosting in a day.

Multiplier (Safety Factor)	Please state the multiplier used

Total Refrigeration Description	Peak Period(kW)	Holding Period(kW)

Cooling System Design Detail

xii) Cooling System Configuration: Mechanical Refrigeration

Type of Refrigerant	Provide technical name of the refrigerant.
Total refrigeration system capacity	Provide the total refrigeration capacity in kW.
Type of System	Direct Expansion/ Gravity Feed/ Overfeed/ Secondary pump.
Type of compressors	Reciprocating/Screw/Scroll.
Type of capacity controls used	Step less/ step in / Auto unloading of cylinders.
Specify Unloading steps in percentage	Screw Compressor from 10 to 100% Reciprocating from 25 to 100%.
Type of condensers	Atmospheric/ Evaporative/water cooled/Air cooled.
Cooling Towers (if applicable)	Natural draft/ Induced Draft.
Type of Evaporators/ Air cooler	Ceiling or Floor mounted - Induced draft/ Forced Draft / Dual discharge.
Type of defrosting system	Air/ Water / Electric/ Hot gas.
Humidification System & Control	Specify the method of humidification equipment used.

Refrigeration Equipment Details

xiii) Compressor/ Rack Detail

Compressor/ Racks Type, Make & Model	Qty.	Comp. RPM	Operating Parameters SST. / Cond. Temp (^{0}C)	Refrigeration Capacity (kW)	Power Consumption (kW)	Total connected Motor (kW)	Remarks Working /Standby
					Full load: Part load:		

xiv) Condenser Details

Condenser Type, Make & Model	Qty	Operating Parameters Condensing Temp.(CT) WBT, water in/out temp(^{0}C)	Condenser Heat Rejection Capacity (kW)	Electric Fan /Pump Motor Rating (kW)	Total Electric Power (kW)	Remarks Working /Standby

xv) Cooling Tower Details (if applicable)

Cooling Tower Type, Make & Model	Qty.	Operating Parameters DB & WB Water Temp, in/out(^{0}C)	Cooling Tower Capacity(kW)	Fan & Pump Capacity (CMH/LPS) & Motor (kW)	Total Electric Power (kW)	Remarks Working /Standby

xvi) Pressure Vessels

Description	**Type Horizontal or Vertical**	**Refrigerant**	**Operating Temp & Pressure**	**Construction Shell, Dish Ends & Nozzles**	**Total Refrigeration load**	**Holding Volume**
Low Pressure						
High Pressure						

Note: The design and testing of the pressure vessel should comply with ASME Sec VIII Div 1.

xvii) Evaporators /Air Cooling Units (ACU)

ACU Type, Make & Model	Nos.	Operating Parameters Evap. (SST) & TD* (^{0}C)	Cooling Capacity (kW)	Air Flow (CMH) & Face Velocity (m/s)	Material of Coil Tubes & Fins	Fin pitch (mm)	Total Fan Electric Power (kW)

*TD – Temperature difference between Evap. (SST) ^{0}C & Return Air (at coil inlet).

Note: Please attach Detailed Technical Performance Data Sheets of each equipment namely Compressors, Condensers, Cooling Towers, Air Cooling Units giving General Layout and Dimensions duly Certified by the respective equipment manufacturers with reference to the Relevant Codes & Standards.

xviii) Electrical Installation:

Total Connected load	Specifies the total connected electrical power in kW.
Estimated power requirement at Peak Load Period	Provide the maximum power consumed during peak demand in kW.
Estimated power requirement at Holding Load Period	List the power consumed during holding period in kW.
Estimated power requirement at Lean Load Period	List the power consumed during lean periods in kW.
Capacity of Transformer	Provide the rated capacity of the transformer in kVA.
Size of Capacitor	Provide the Size of capacitor bank for power factor correction & their operation.
Make & Capacity of standby D.G. Sets	Provide the make and rated Capacity of the Generator in kVA.

xix) Material Handling procedure

Procedure	Brief Description
Material Handling Procedures & Equipment	Describe the details of product movement inside the cold storage and equipment used.
Capacity of mechanised belt conveyor if any -Rating of motor	Electric motor capacity in kW connected for lifts / hoists / conveyors etc.
Any other device please specify	

Attach a Plan & Layout of the proposed Cold Store unit approved by a Registered Architect.

xx) Safety Provisions : Mandatory
Include Machine room ventilation system for self-containing

	Yes / No
Fire Fighting equipment as per Fire safety standards of State Fire Department installed	All Fire -fighting equipment complied as per state Fire- fighting department
Refrigerant Leak detections system	Specify the use of leak detection system
Safety devices– LP/HP cut outs, safety valves, shut off valves etc. installed	
Emergency lighting in Cold chambers & other areas installed	
Lightening arrestors installed	
Any other safety provisions installed (describe)	

xxi) Energy Saving Equipment & Measures

Details of Energy Saving devices	Brief Description and Savings
Light Fixtures (Internal / External)	Provide type of light fixtures-CFL/LED numbers and wattage.
Natural Lighting for general areas	List the provision for natural lighting is included.
VFD / Electronic Technology for fans / compressors	Control of fan motors speed using variable frequency drives or by electronic technology in 2 steps fan for evaporators.
Refrigerant Controls and Automation	List the automation controls used to save energy for optimizing the performance of the refrigeration system.
Air Purger	Provide the type and operation of air purger.
Power Factor Controller	Measure of efficient use of electrical power in the connected system.
Energy recovery	List use of energy recovery for ventilation system.
PLC Control & Data Acquisition	Automation for monitoring and control of the parameters and Refrigeration plant.
Any other components	List use of water treatment for recycling of water and rainwater harvesting etc.

xxii) Estimated Performance Parameters of Proposed Cold Store

Parameters	Peak Period	Holding Period
Coefficient Of Performance (COP) of the Cold Store Unit	Specify COP of the cold storage during peak and holding periods.	
Power Consumption (kWh/Day)	Specify power consumption during peak and holding period.	
Prevailing Electricity costs	Specify prevailing electricity costs in Rs/kWh.	

xxiii) Brief description of any other technologies or infrastructure used

Reefer trucks operated (if any)	
Specialised packaging lines(if any)	
PLC Automation(if any)	
Dock Levellers systems(if any)	
Alternate energy options(if any)	
Modern Pack-house(if any)	
CA technology(if any)	
Others	

Append details in separate data sheets for 'add-on components' if also applying for these components.

All mandatory rules & regulations (BIS, ISO, IS etc.) relevant to the item must be complied with.

CA GENERATOR

Component Definition

The component name CA generator refers to specialised system that produces and controls inert gas (normally Nitrogen) for use in Controlled Atmosphere (CA) enabled refrigerated spaces. The CA system for a Cold storage includes the Nitrogen (N_2) Generator, pressure regulating valves, sensors, various analysers and dedicated PLC control panel.

Component Description

Under MIDH norms beneficiary may apply for maximum 2 units as part of add-on components for credit linked subsidy. The cost norm applicable is Rs 1.25 crores per unit and refers to a complete CA generation & monitoring system generating upto 70 cum per hour for use in the chambers.

The component "CA Generator" refers to a complete system with below components:

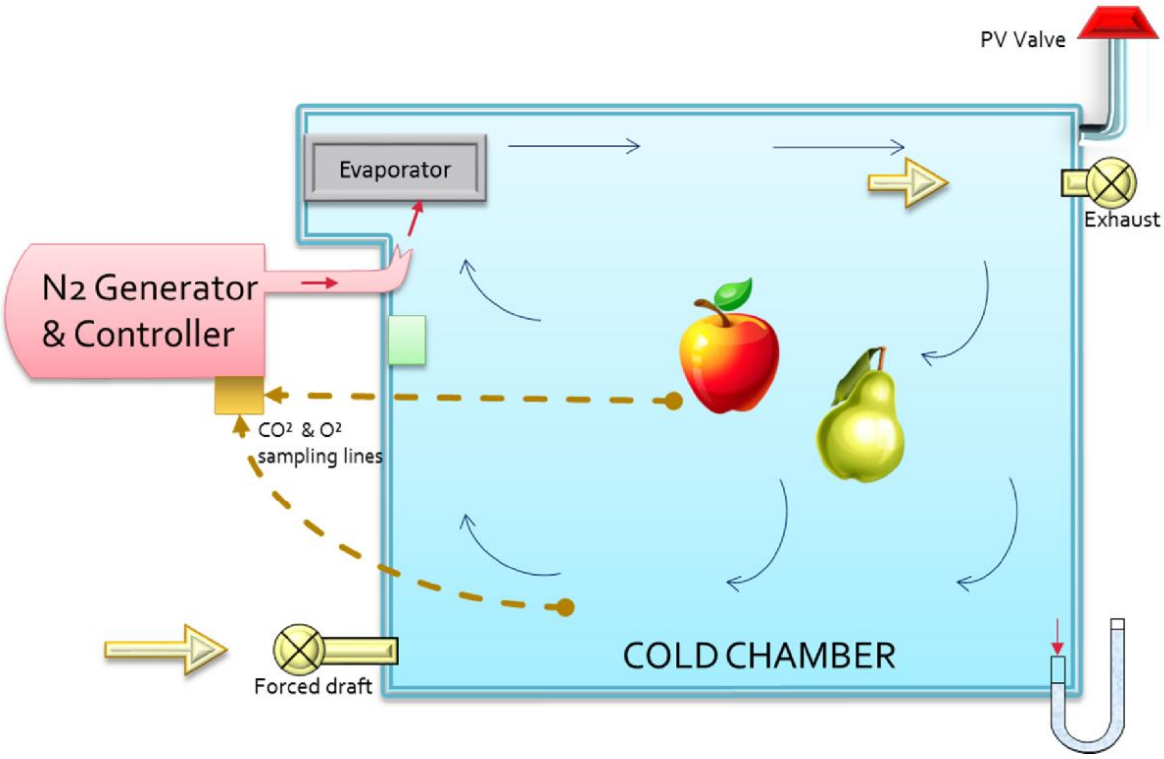
1. **CA (Nitrogen) Generator:** Nitrogen (N_2) Generator is a primary necessity to actively control the atmosphere and are generally of two types - Pressure Swing Adsorption and Membrane based technology. The cumulative capacity of the inert gas generator deployed depends upon the size of the cold chambers and loading rate of each chamber. For use in fruits like apple and pears, the pull down time (total time to bring chamber parameters down to storage atmospheric parameters) should be less than 72 hours. The N2 generator is also connected with nitrogen buffer tanks, injection valves and connected through the feed lines to each cold chamber. The equipment works in sequential mode, as each chamber is filled with cargo, and the total generation capacity need not match the total volume of all chambers.
2. **Sensors and Analysers**: for measuring Carbon dioxide and Oxygen concentration levels
3. **Control System**: With electronic hardware and software for controlling and monitoring of CA equipment operations. A dedicated PLC based system is used.
4. **CO_2 Absorber**: Such systems may also include CO_2 Absorber to control the level of carbon dioxide within the refrigerated enclosures (cold rooms). The CO_2 absorber is connected to the each of the cold chambers through pipelines, valves and a breather bag. The capacity of the CO_2 absorber depends upon the size of the cold storage, type of product stored and pull down time.

Remarks / Recommendations

The CA Generator as add-on component is intended to facilitate use of CA technology for both new and existing projects. As an add-on component, this technology is now available to plan partial and selective resource utilisation such that a select number of chambers can be dedicated to controlled atmosphere cold storage, while others can be constructed to cater to other quality types. Hence, an infrastructure facility is not forced by design to reject farmers with non-grade produce but can opt to cater to the total offtake from the producer (this will also build improved aggregation and relations between facilities and producers).

As an add-on component, this also supports conversion of existing cold storages in Hilly states of Himachal Pradesh, Uttaranchal and Kashmir to develop CA enabled cold chambers; along with modernisation of refrigeration (refer MIDH Operational Guidelines- Appendix II (ix)) and modernisation of insulation (refer MIDH Operational Guidelines– Appendix II (x)) and installation of Specialised CA Doors (refer MIDH Operational Guidelines- Appendix II (ii)).

Another option available under CA based technology is the introduction of CA tents which are low cost options where even partial chamber volume utilisation can be done under CA conditions (see MIDH Operational Guidelines, Appendix II (iii)).

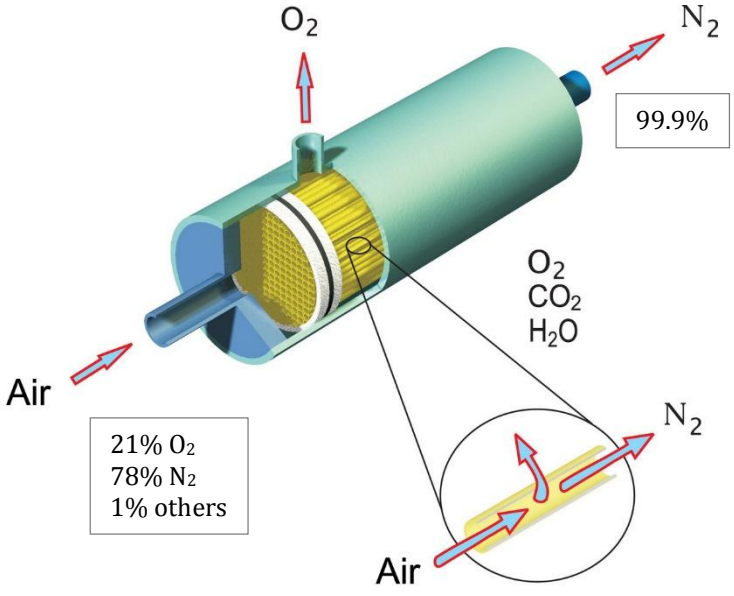


Schematic of CA enabled cold store

Membrane based Nitrogen Generation

Hollow fibre membranes (semi-permeable) are used to filter out oxygen from atmospheric air, allowing for a nitrogen rich output from the membrane cylinder. Nitrogen purity up-to 99.99% is obtained.

(Our atmosphere is 78% nitrogen and available in abundance, making it suitable as the purging medium for obtaining low oxygen levels in a chamber)



Reference Data Sheet

#	Component: CA Generator	Description
A	**Nitrogen Generator**	Specify design 0_2 percentage.
1	Make and Model number	Manufacturer name and model number.
2	Type	Specify whether PSA/VPSA/membrane based.
3	Capacity of each Generator	Provide the output capacity of each generator in m^3/hour.
4	Total volume of chamber*	Total volume of all storage chambers in m^3.
5	Free Volume	Free volume in each chamber in M^3 after full load.
6	Pull down time	Total time (in hours) to bring room oxygen level to the designed oxygen percentage.
7	Nitrogen Buffer Tank capacity	Provide the nitrogen buffer tank capacity.
8	Capacity of breather bags	Provide the capacity of breather bags.
9	Power Consumption	Provide the electrical power consumption in kW.
B	**CO_2 Absorber**	Specify design CO_2 percentage.
10	Make and Model Number.	Manufacturer name and model number.
11	Product Stored	Specify the horticulture product to be stored.
12	Capacity of Absorber	Capacity of absorber in kgs per 24 hours at 3% level
13	Pull down time	Specify the total time (in hours) to bring CO_2 levels to designed CO_2 levels in percentage.
14	Power Consumption	Electrical power consumption of each absorber in kW.
15	Control Valves	Specify the control valves used for controlling and monitoring in the system.
C	PLC Control System	Description of PLC control system for controlling and monitoring of CA equipment operation.
16	Sensors and Analyser	Specify the sensor and analyser used for measuring carbon dioxide and oxygen centration levels.
D	Safety O_2 monitors	For operating staff to alert low oxygen conditions. Minimum 3 per facility, necessary for safety of staff.
E	Other fittings (description)	
17	Gas tight Fittings	Chambers must be gas tightened to avoid leaks
18	Pressure relief valves	Each chamber for CA must have PV valves

*3.4 m3 of chamber volume shall be considered equivalent to 1 MT of storage capacity (Refer MIDH operational Guidelines, Sec. 7.47, Pg. No.21).

Codes and References		
1	ISO 6949 ; 1988	Fruits & Vegetables - Principles and techniques of Controlled Atmosphere storage.
2	ISO 1212 : 1995	Apples Cold Storage.
3	ISO 1134 : 1993	Pears Cold Storage.

All mandatory rules & regulations (BIS, ISO, IS etc.) relevant to the item must be complied with.

SPECIALISED CA DOORS

Component Definition

This component refers to Insulated doors specially designed for controlled atmosphere storage rooms. These doors are constructed with thermally insulating material and include seals that insulate and also ensure airtightness to isolate internal oxygen & carbon dioxide levels from the external atmospheric parameters.

Component Description

A beneficiary may apply for CA Doors as credit linked back ended subsidy with a maximum capital cost of Rs.2.50 lacs per door and up-to a maximum number of 20 doors. The cost norm is not intended to restrict the user a choice to install doors of bigger dimensions and with added automation options.

The component "Specialised CA Door's" comprises below items:

1. **Door:** Door is constructed of panels with insulating material and of suitable thickness to ensure the chamber space can maintain inside temperatures against a worse case outside temperature scenario.
2. **Sealing:** the door panels seal against the chamber wall with inflatable or special gasket material held in plastic / aluminium profiles.
3. **Rails**: normally metallic channel profiles, tolerant to moisture with rollers or wheels equipped with bearings for ease of mobility are used. Other suitable mechanisms can be considered.
4. **Opener**: are specialised lever handles on both sides of the door with a securing and releasing mechanism.
5. **Windows**: vacuum sealed inspection ports, with anti-mist glass and appropriate access system.
6. **Emergency door Opener:** a mechanism to quickly release and open a door that may be inadvertently close from outside.

Remarks / Recommendations

The concept behind introducing the CA Doors as a subsidy component allows its utility to extend to both new projects as well as for the modernising of selected chambers in existing cold stores to make them capable for CA storage. It may be noted that the airtightness of the doors is one of the key points to maintain the desired CA conditions.

The metallic material used in constructing the doors and its opening mechanism is moisture resistant and normally of stainless steel or anodised aluminium, with nylon as the material of choice for the rollers. As new materials are made available, those will also be considered for suitability of application.

A door opening size of 2.5 x 3.5m has been considered for the sake of these norms and user may choose varied sizes with associated actual cost. Doors can be motorised or manually operated doors. It is recommended that the beneficiary use identical door sizes and also stock a few spare parts for common use between all doors installed.

Reference Data Sheet

#	Component: CA Door	Description
1	Name of Manufacturer	Name of manufacturer and model
2	Size of the door	Door dimension (Height, Width, Leaf Thickness)
3	Insulation material	Specification of the material and thickness with its 'U-value'.
4	Sealing type	Specify the door sealing type -Inflatable/gasket.
5	Sighting ports	Dimensions of visual monitoring port with anti-mist glass.
6	Emergency Door opener	Confirm internal emergency door release fitted (Y/N)

Codes and References		
1	IS 661	Code of Practice for Thermal insulation of Cold storages
2	IS 12436 - 1988	Specifications for Rigid Polyurethane
3	DIN 55928	Specification of Galvanised steel Cladding
4	EN 13241 -1	Construction of Industrial Doors

All mandatory rules & regulations (BIS, ISO, IS etc.) relevant to the item must be complied with.

CA TENT

Component Definition

This component refers to an airtight enclosure made of impermeable material such as polyethylene PVC, Mylar so as to serve as a sealed enclosure which can maintain controlled atmosphere parameters for storing perishable produce. The impermeable body is designed with various fitments necessary for gas introduction and air sampling lines.

Component Description

A beneficiary may apply for maximum 5 enclosures as part of add-on technology for credit linked subsidy, within the maximum admissible under Appendix-II. This does not limit the cold-chain facility from utilising more CA tents as per requirement or from sourcing equipment with higher costs or options.

The component name "CA Tents" consists of following admissible items under this subsidy component:

1. Impermeable enclosure - like polyethylene PVC, Mylar
2. Sealing mechanism - to create an airtight seal at the opening after loading.
3. Pressure Relief valve-to control the pressure within the CA tent.
4. Piping - that allows the tents to be removed easily and rolled up to be stored, if desired.
5. Gas cylinders to store the inert gas.
6. Control and atmospheric analysis system.

For inerting the space, a CA generator (nitrogen generator) or nitrogen cylinders can be used to change and control the atmospheric conditions. CA tents can be applied for in regions other than where conventional CA based cold stores are built (apple and pear growing areas), for using with non-conventional goods.

CA tents are uncommon technology and proposals for this component shall be considered on a case to case basis. Users will be guided on the suitability of the application in relation to submitted costs for due consideration.

All safety norms shall be complied with as and when applicable.

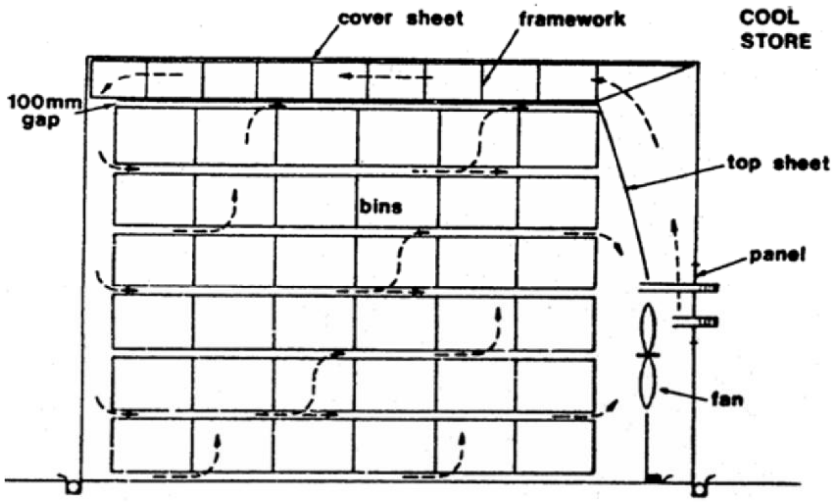
Remarks / Recommendations

This component is introduced with intention to facilitate the option of CA technology for small volume loads and for regions where complete CA infrastructure is considered prohibitive. Such an option also allows an existing cold store to opt for a low cost solution and bring into use a single chamber or insulated space for controlled atmosphere applications.

CA tents are easily set up and removed and thereby allow flexibility in use of storage space. By using CA Tents a pre-existent storage can tap into this technology for opportunity and experimentation in CA utilisation. Inside the CA Tent a controlled atmosphere is actively created and controlled by an automatic system which by means of air component analyses manages the valves, lets in storage gas or balancing air and hence maintains the correct parameters for each

product in order to lengthen the storage period. CA tents also allow the use of other gas types like CO_2 for storage of horticulture produce.

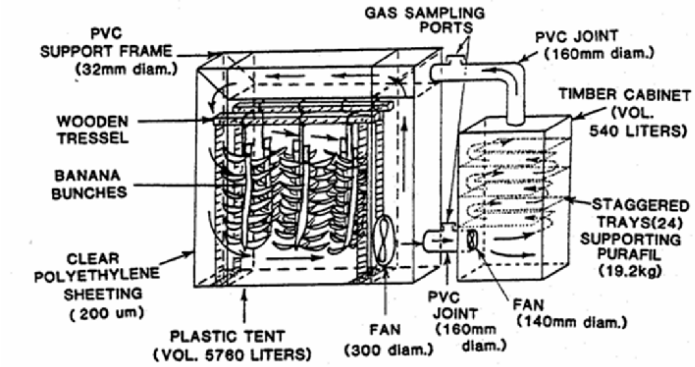
CA tents are usually constructed with a continuous sheet material so as to reduce the number of seals required. All joints and seams of the tents are heat welded. Punctures in the tent are also a concern and care should be taken during installation and removal since a puncture within a tent can be more difficult to locate. Multi-layered material helps mitigate the risk of developing leaks. Ensure that all products being placed in a CA tent are thoroughly cooled before sealing the tent. Some CA tents come fitted with internal blower or air flow systems to aid in circulation and cooling.

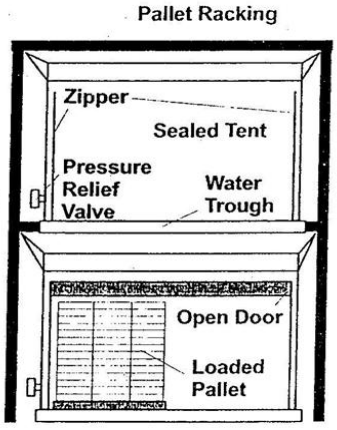


Controlled atmosphere storage using plastic tents. International Institute of Refrigeration.

Scehmatic-1

A low cost plastic tent fashioned from clear polyethylene sheeting can be used for controlled atmosphere storage of bunches of green bananas. A small fan serves to circulate the C.A. storage air (2% O2 and 5% CO2) through a chamber of potassium permanganate on aluminium oxide. The shelf life of bananas under these conditions is four to six weeks at ambient temperatures. Normally a full-fledged infrastructure for a few weeks extra storage is not justifiable. *Schematic-2*





Scehmatic-3 shows two C.A. tents. The top tent has been sealed by closing zippers on both sides of the door and immersing the bottom in a trough of water which serves as a seal. The trough is made using a 6 inch diameter PVC pipe (with 1/3 of the pipe cut away), which also allows supply and sampling gas lines and temperature probe wiring to pass into the tent. All seams and joints of the tents are heat-welded. The bottom tent is shown with the door rolled open and part load of produce loaded into the tent.

Information and schematics sourced from FAO website

Reference Data Sheet

#	Component: CA Tents	Description
1	Name of Manufacturer	Manufacturer name and model number.
2	Material Used	Describe the material used for airtight enclosure.
3	Number of layers /thickness	Number of layers and the thickness of material.
4	Dimensions	Physical dimensions of the enclosure.
5	Capacity of Gas Cylinder/CA generator	Provide the gas holding capacity of the cylinder along with material used.
6	Air sealing mechanism	Describe the air tight sealing used in terms of mm of mercury.
7	Atmosphere control & analysis system	Specify the system used for monitoring and controlling of parameters.
8	Pressure relief valve	Specify the valves used to control the pressure within CA tent.
9	Piping connections	Specify the material of the piping used and its connections.
10	Number of Air Sampling lines	Specify the number of sampling lines used.
11	Internal fan/Blower rating	Specify the rating of internal fan/blower used to circulate the CA storage air, if any.

*3.4 m3 of chamber volume shall be considered equivalent to 1 MT of storage capacity (Refer MIDH operational Guidelines, Sec. 7.47, Pg. No.21).

Codes and References		
1	ISO 6949 : 1988	Fruits & Vegetables - Principles and techniques of Controlled Atmosphere storage.
2	ISO 1212 : 1995	Apples Cold Storage.
3	ISO 1134 : 1993	Pears Cold Storage.

All mandatory rules & regulations (BIS, ISO, IS etc.) relevant to the item must be complied with.

PROGRAMMED LOGIC CONTROLS

Component Definition

In cold-chain facilities, a Programmed Logic Controller comprises electronic hardware with pre-programmed software, physical refrigeration controls and various sensors so as to automate operations of machinery. The system continuously monitors operating conditions through sensors and the PLC processor serves as the "decision making unit", directing electro-mechanical controls to automate and optimise the function of the machinery.

Component Description

Under MIDH norms beneficiary may apply for 50% of cost incurred as per original invoice, within a maximum of Rs.10 lakh as part of add-on components as credit linked subsidy. This does not limit the cold-chain facility from utilising additional automation as per requirement or from sourcing equipment with higher costs or options.

The component name "Programmed Logic Controller (PLC)" provides for a system with a wide range of items including temperature/pressure/level sensors; compressor and condenser controls; speed control of compressors, condensers and fans; evaporator controls with thermostatic expansion valves; evaporator controls with electronically operated expansion valves, programmable system management and remote monitoring units. The major admissible items under this subsidy component can include:

1. Processor unit, including computerized display and indicators.
2. Sensors for humidity, temperature, CO_2, pressure, etc.
3. Report Generator: HACCP/log data can be generated or hard copy chart recorder for chamber temperature and humidity records.
4. Alarm signalling system: probe errors, minimum and maximum temperature sensing alarm, compressor protection, evaporator fan control.
5. Direct or pump-down control of motor compressor unit.
6. Automatic and manual defrost control, activation/deactivation controls.
7. Room light activation, via panel key or door switch.
8. Thermic breakers, adjustable breakers, solenoid valves.
9. Level switches, multi-directional Valves, Relays, other accessories.
10. Remote monitoring (SMS through GSM/GPRS, online or e-mail with LAN).
11. Depending on need and utility, many combinations of sensors and controls can be utilised.
12. This list is not intended to be restrictive basis end user application.

Safety codes and standards as applicable to PLC equipment and accessories shall apply.

Remarks / Recommendations

The concept behind introducing this component is to incentivise automation to bring energy efficiency in existing and upcoming cold stores as a policy direction. This incentive option could

greatly benefit existing cold stores through one time modernisation and automation that effectively optimises the operating times and parameters of their cooling equipment.

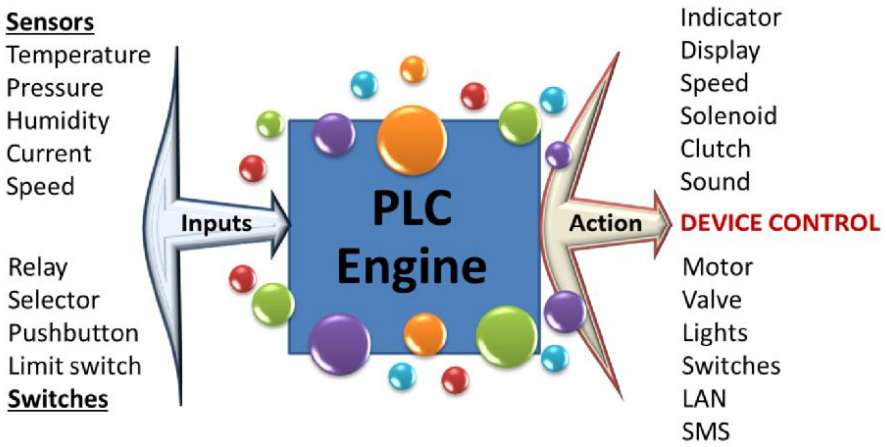
PLC is designed for multiple inputs and output arrangements, extended temperature ranges, immunity to electrical noise and resistance to vibration and impact. Programs to control machine operation are typically stored in battery-backed-up or non-volatile memory. PLC shall be compatible with Temperature sensors, pressure transmitters, liquid level control transmitters and gas detection sensors for electronic control of refrigeration applications.

Various equipment suppliers offer options in design specifications which will reflect in the cost of this component. The subsidy is intended to incentivise use of PLC equipment in cold-chain and actual chargeable costs can vary depending on design. Project appraisers may note that a lower cost structure could apply depending on the number and type of equipment used. As an approximate thumb rule cost per chamber should be in the region of Rs 25,000 to 40,000.

The Controller should be capable of managing not only traditional safety systems such as compressor alarms common high and low pressure switches, high condensing pressure prevention etc., but also several other safety systems, for example - Backup pressure probes, only if the main probes fail, Discharge temperature monitoring on each compressor, Protection against high condensing pressure using evaporative cooling, protection against low suction super heat, sign-of-life for activation of backup systems, Anti-liquid return output, Double alarm priority Internal log, Internal configuration backup.

Optimally designed systems not only save energy but protect stored cargo from risks, allow efficient use of built-in redundancy, facilitate planned maintenance vis. breakdown repairs, among others.

Inputs feed programmable CPU or ladder logic which in turn allows intelligent action or alerts.



Schematic by NCCD

Reference Data Sheet

#	Component: Programmed Logic Controls	Description
A	**Design & Construction**	
1	Name of Provider	Name of system provider.
2	Processor system	Specify the make and model of the processor.
3	Number of Input (IU)/ Number of Output (OU)	Enumerate the number of inputs and outputs for associated controls provided in the PLC.
4	Type of Report generation	Describe the pattern of data logging.
B	**Refrigeration Plant Controls**	**Refrigeration Control included: Yes/No**
5	Compressor	
6	Compressor rack control	
7	Condenser fans	
8	Evaporator fans	
9	Water Circulation pump	
10	Liquid ammonia circulation pump	
11	Defrost control	
12	Liquid Level Controls	
13	Describe Control of level switches, valves, relays, breakers.	
14	Any Others	Lights, remote LAN based control, alarm control, internal logging control etc.
C	**Room Parameter Controls**	**(Yes/No)/Describe the controls of room parameters.**
15	Temperature	
16	Relative Humidity	
17	CO_2,O_2,Ethylene levels	
18	Any Others	Room light activation, Door opening, fail safe triggers, other system flags, etc.
D	**Plant Safety Operation**	**(Yes/No) - Describe configuration.**
19	Compressor protection	
20	Evaporator fan control	
21	High condensing pressure alert	
22	Minimum and maximum temperature alarm	
23	Back up pressure probe	
24	Discharge temperature monitoring	
25	Protection against low suction super heat	
26	Any others	

Codes and References		
1	IEC	International Electrical Code.
2	IS 732 1963	Code of Practice for Electrical wiring Installation.
3	HACCP	Hazard analysis and critical control points

All mandatory rules & regulations (BIS, ISO, IS etc.) relevant to the item must be complied with.

DOCKS LEVELLERS

Component Definition

This component applies to a docking bay system that includes an adjustable metal ramp designed to bridge the gap between the cargo bed of a transport vehicle and the loading platform of a cold-store, the dock shelter which incorporates a sealing system and an inner insulated door.

Component Description

The cost norm applicable is Rs 7 lakh per complete assembly for maximum 5 dock leveller assemblies, as part of add-on components under MIDH. In cold-chain facilities a complete assembly will normally comprise an adjustable ramp, an insulating dock door and temperature sealing dock shelter. The cost norm does not limit the cold-chain facility from utilising more dock-leveller assemblies as per requirement or from sourcing other equipment or options.

The component "Dock levellers" requires of electrical, hydraulic/pneumatic operations for the leveller and an associated dock door and applicable safety controls must be installed. The major admissible items under this subsidy component are:

1 **Adjustable ramp**: a load bearing ramp with at least one hydraulic or pneumatic ram (cylinder). The platform must have appropriate anti-slip surface and the dimension considered is 3m x 2.5m. Smaller sizes would have a lower unit cost. A point load capacity of 6 tons is considered. The cost norms do not restrict the user from using higher capacity or design criteria.

2. **Dock Shelter**: The cost norm also considers a loading bay with retractable rubberised flaps that form an air seal against the truck body. This minimises the uncontrolled loss of air from cool ante-room (staging area), during loading/unloading operations from the gap between truck sides and loading door. Each flap seal is of sufficient width so as to allow for standard variations in truck dimensions. Inflatable and cushion seals are other design options for the sealing mechanism, though flap type is most common for ante-room operations for chilled range use. The dock shelter incorporates bumpers/fenders to protect the civil structure from impact damage from vehicles.

3. **Dock Door**: The dock leveller component shall also incorporate insulated dock doors. An opening size of 2.5 meters x 3 meters with a motorised sectional door is considered for the purpose of these cost norms. The insulation material should be designed to suit the utility. Users may use variations in sizing for their specific utility.

4. **Safety Controls**: There shall be integrated controls with emergency OFF switch, restart inhibition, press and hold actuation.

All extant safety norms as applicable to these components must be complied with.

Remarks / Recommendations

The concept behind introducing this component is to facilitate use of technology options that mitigate the risk to produce from temperature excursions during the critical loading and unloading operations of perishables. Utilisation of such equipment by cold-chain facilities will

additionally contribute to reducing energy load from heat infiltration, thereby reducing energy wastage and easing of operating costs. Such equipment also promotes good practises of palletised or unit load handling in cold-chain.

Dock leveller systems are used worldwide for ensuring smooth transfer of goods into and out of cold storages and facilitate the effective operation during loading and unloading.

Additionally, these facilitate unit load or palletised cargo handling - Unit load handling helps to minimise wastage that occurs due to poor handling practises of perishables during storage and transport. The complete assembly not only helps minimise energy loss by forming a sealed bridge between the vehicle and cold store, but by allowing for faster operations, it thereby further reduces the risk of temperature excursions in the cold chain.

Various equipment suppliers offer options in design specifications which also reflect in the total cost of this component. The subsidy is intended to incentivise good practises in cold-chain and beneficiary should be advised not to directly compare the budgeted cost norm with the actual chargeable costs.

It may be noted that this component would have a much lower cost structure when used in facilities that do not incorporate a shelter or insulating doors (in case of old stores that do not have anterooms, or in case of facilities where these are mounted on uncovered platforms). A plinth height of 1.2 mtrs.is recommended norm for using levellers.

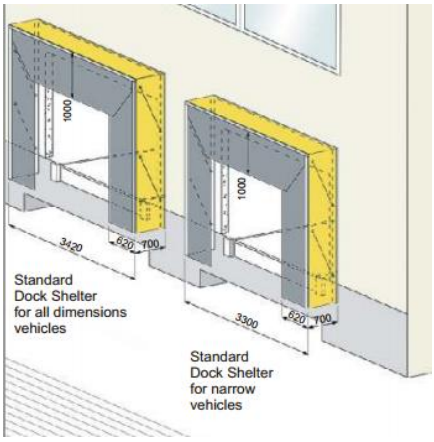
Material handling equipment such as pallet lifters, forklifts, high reach material handling equipment, etc. should be used to enhance safe handling and productivity.

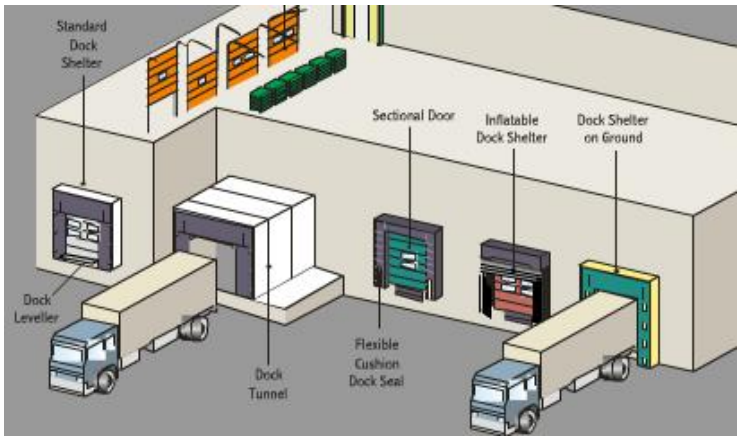
The docking system shall have insulated doors and the bed constructed to withstand the dynamic loads of the assembly. The cost of civil work for constructing a pit in existing cold stores may be included when this component is used for modernisation.

Sheltered dock with leveller and insulated Door

Adjustable Ramp for loading

Docking bay in use





Photographs sourced from NCCD members

Reference Data Sheet

#	Component: Dock Leveller System	Description
A	**DOCK LEVELERS**	
1	Name of Manufacturer	Manufacturer name and model number.
2	Type of operation	Method of operation used by leveller-electrical/hydraulic/ Pneumatic.
3	Ramp-Platform Material	Material used for ramp and thickness of material.
4	Number of cylinders	Describe operation with single cylinder/double cylinder.
5	Platform size	Dimensions of the platform (W x L) mtrs.
6	Max vertical Lift up & down	Maximum and Minimum safe vertical lift capability (up & down position) in mm.
7	Load capacity	The point load capacity of the leveller in tons.
8	Plinth height of facility	Specify the height of the plinth in mtrs.
9	Control Panel	Specifications and functions available in the control panel used.
10	Standard safety provisions	List all safety provisions incorporated-e.g. safety stop valve/ switch integrated in the lift cylinder
11	Emergency stop switch	Emergency OFF switch (all-pole-cut-out) is used (Yes/No).
12	Dock pit dimensions	Dimensions of the pit formation in mtrs.
13	Power consumption	Total power consumption of the entire system in kW.
B	**DOCK DOORS**	
14	Manufacturer and model	Manufacturer name and model number.
15	Dimension of Door opening	Dimensions of the door.
16	Loading area temperature	Temperature of the loading area in degree Celsius.
17	Insulation	Provide the material, thickness and its 'U-value'.
18	Safety Provision	Provide all safety provisions provided.

#	Component: Dock Leveller System	Description
C	**DOCK SHELTER**	
19	Name of Manufacturer and model	Specify the name of the manufacturer and type of design (flap, inflatable, others).
20	Dimensions	Specify the dimensions of the dock shelter.
21	Sealing Material & type	Describe the sealing material used to minimise energy loss, and width of seal.
22	Bumper	Specify the size/dimensions of the bumper used in the dock shelter as a protective mechanism.
23	Safety Provision	Specify all safety provisions provided.

Codes and References		
1	IS 661	Code of Practice for Thermal insulation of cold storages.
2	IS 12436 – 1988	Specifications for Rigid Polyurethane
3	DIN 55928	Specification of Galvanised steel Cladding
4	EN 13241 -1	Construction of Industrial Doors
5	EN 1570	Dock Platform Construction
6	EN 1398:2009	Safety aspects of dock levellers

All mandatory rules & regulations (BIS, ISO, IS etc.) relevant to the item must be complied with.

WDRA-NWR EQUIPMENT

Component Definition

This component supports equipment for meeting WDRA (Warehouse Development Regulating Authority) requirements to issue NWR (Negotiable Warehouse Receipts) in case of cold stores.

Component Description

Cost norm applicable is maximum Rs 2 lakhs per establishment for computerisation to issue NWR as per WDRA requirements, as part of add on components for credit linked subsidy.

The Major Admissible items under this subsidy component are:

1. Maximum two computers
2. Printer for printing NWR with initial consumables for 6 months.
3. AMC for one year.

The facility should have already completed WDRA accreditation process before applying for this component.

Remarks/ Recommendations

The subsidy is intended to incentivise use of dedicated hardware for operations and receipt generation as per WDRA guidelines.

All hardware shall be of reputed make and compatible for operating WDRA designed software. WDRA shall be providing related software free of charge or as per extant policy. Cold stores applying for this component should furnish information of having undergone WDRA accreditation process and should be storing perishable produce as notified by WDRA.

Reference Data Sheet

#	Component: WDRA-NWR Equipment	Description
1	Computer Type / Quantity	Name the manufacturer & model and hardware /software configuration for each.
2	Printer type	Name of the manufacturer and model number.
3	Type of produce	Specify the type of cargo that shall be handled and annual quantity that will be issued NWR.
4	AMC	Specify whether applied for annual maintenance contract for the equipment against which subsidy has been applied for if so the details thereof.
5	WDRA accreditation	Provide the application number, date of applying and the date on which accreditation was granted.
6	Storage capacity	Specify the volumetric storage capacity available.

All mandatory rules & regulations (BIS, ISO, IS etc.) relevant to the item must be complied with.

SPECIALISED PACKAGING

Component Definition

This component refers to a group of integrated special-purpose equipment that combines produce with packaging inputs and output a ready to handle packaged product. Each packaged product should have farm code labelling in alignment with traceability norms.

Component Description

The maximum admissible cost norm is Rs.15 lakh for a specialised packaging system. The actual value of the equipment will be proportional for lesser capacities or design options. This does not limit the Cold- Chain Facility from utilising more advanced packaging systems, or from sourcing equipment with other options.

The Component name "Specialised packaging" is an automated packaging system that may consist of:

1. Weighing Machine-to ensure packages meet fill weight requirements by checking the final weight of the filled product.
2. Final Packaging (Packing Table)- having the capability of metering final product into a packaged unit, meeting exact weight requirements, and transferring the box to the next station when it is full.
3. Coding and Labelling system that marks each product with farm code (source of produce) and the date of harvest or packaging. Records should be kept available as guided by extant norms.
4. Packaging material of reasonable quantity for a period of 6 months.

Such packaging system is normally appended to the end of the sorting grading line. All applicable safety and performance norms shall apply to a packaging system.

Remarks/ Recommendations

Various equipment suppliers offer options in design specifications which will reflect in the cost of this component. The subsidy is intended to incentivise use of Specialised Packaging in the cold-chain and beneficiary should be advised not to directly compare the norm with actual chargeable costs. Most importantly, the packaging system should have capability to undertake farm code labelling which is necessary for exports and domestic trade and in compliance with the intent of the regulations of the Food Safety and Standards Authority of India.

Specialised packaging line shall be well designed for optimal throughput and to enhance operational efficiency. RFID tags can also be used for improved inventory management.

A packaging line shall comply with the goal of a) containing the product and facilitating the handling and marketing by standardising the number of units or weight inside the package; b) enabling packaging which protects the cargo from damages and injuries while storing and transporting; c) equipping the packaged material with appropriate labelling or coding to enable traceability of all product information.

Reference Data Sheet

#	Component: Specialised Packaging	Details
1	Name of Manufacturer	Name of manufacturer and model.
2	Feed line	Indicate the operating method of the feeding line- automatic/manual.
3	Sorting Grading unit	Provide details of appended sorting & grading line with hourly capacity.
4	Weighing Machine	Capacity of the weighing machine and type of weighing mechanism.
5	Final Packaging	Describe the type of packaging the packaging line is capable of.
6	Traceability system	Provide details of traceability system used for the packaging line – ability to assign farm codes, build code plan to print labels, RFID Tags, etc.
7	Labelling System, printing system.	Describe the type of labelling done on the packaging line also enumerating the details provided in the label.
8	Throughput capacity	Describe the number of packages that the line can throughput in a day/hour.
9	Total Power consumption	Provide total electrical power consumption of the line.

All mandatory rules & regulations (FSSAI, BIS, ISO, IS etc.) relevant to the item must be complied with.

HIGH REACH MHE

Component Definition

A High Reach Truck is a mechanized industrial lift truck equipped with a vertically elevating load carriage frame and horizontal load forks for lifting and positioning the pallets and wooden bins. Reach trucks are powered by an IC engine / Electric motor powered by battery.

Component Description

The maximum admissible cost norm is Rs 17 lacs for a High Reach Truck subjected to a maximum of two High reach trucks. This does not limit the Cold- Chain Facility from utilising more advanced High Reach trucks or from sourcing equipment with other options.

The Component name "High Reach Truck" may consist of following components:

- Truck Frame - to which Axles, Wheels, Counter Weights and Power Source is attached.
- Electric Power Source with backup battery.
- Carriage-to which forks or other attachments mount
- Forks that allow the operator to lift and move Pellets.
- Battery bank that would supply energy for the operation of the Truck.

All standards and norms as applicable for such vehicles must be complied with.

Remarks/ Recommendations

The subsidy is intended to incentivise use of Specialised High Reach trucks for automating the operation of the cold chain. High Reach Trucks ensure smooth and quick movement of goods within a cold store.

High Reach trucks shall be well designed for optimal reach height and lifting capabilities. Other safety installations when using this equipment must be installed on site. It is recommended that spare parts and a battery charging station be installed. The battery charging station should be outside food storage spaces.

Reference Data Sheet

#	Component: High Reach MHE	Description
1	Name of Manufacturer	Name of the manufacturer and model.
2	Attach specifications	Provide specification sheet of equipment manufacturer
3	Safe Working load	Safe working load as specified by the manufacturer at highest and lowest fork lift level.
4	Maximum Reach	Specify the Highest workable reach at safe working load.
5	Mast height	Specify closed mast height in meters.
6	Turning Radius	Specify the turning radius of the MHE (mtrs).
7	Battery capacity	Provide the capacity of the batteries used as a power source in Ampere-hour.
8	Backup battery	Provide the capacity of backup battery bank used as a buffer in Ampere-hour.
9	Capacity of Battery Charger	Detail the specification/capacity of the battery charger used.

#	Component: High Reach MHE	Description
10	Safety Protection	Enumerate the safety provisions included for safe operation of MHE and for the driver.

Codes and References		
1	CE	Quality Certification for Design and Manufacturing of Material handling system
2	ASME/ANSI B56.5 1988	Safety standards for Guided Industrial Vehicles.

All mandatory rules & regulations (BIS, ISO, IS etc.) relevant to the item must be complied with.

MODERNISATION OF REFRIGERATION

Component Definition

This component refers to up-gradation of refrigeration systems in existing cold storages so as to result in substantial and measurable reduction in carbon footprint of the facility and reduction in the recurring cost of the power consumed.

Component Description

The cost norm applicable is 50% of cost incurred, evaluated as per original invoice, with a maximum admissible cost of Rs 100 Lakhs but not more than Rs 2500 per MT of the cold store capacity.

The component "Modernisation of Refrigeration" may include the following items:

1 Up-gradation of Evaporators.
2. Up-gradation of Compressors.
3. Replacement of Refrigeration Valves including Electronic Expansion valves
4. Automation with PLC/ microprocessor based monitoring and controls.

Modernisation must result in a change to more efficient refrigeration system which brings at least 5% reduction in energy consumption of the subject facility. Each up-gradation case must submit existing energy consumption patterns.

Details of equipment will be evaluated to identify a clear technology improvement with associated "greening" of the utility. Beneficiaries must not confuse this component for capacity scaling or refurbishment of equipment under modernisation.

This component may also be utilised in special cases where compliance with Montreal protocol is mandated (change of refrigerant and system).

Remarks / Recommendations

The concept behind modernisation of refrigeration is to improve the energy efficiency and enhance safety of refrigeration plant for existing cold storages.

This component will typically manifest, where possible, as upgrading of open tube evaporators type and others to more energy efficient evaporators which meet food safety and product safety criterion. Similarly low efficiency compressor systems may be upgraded to improved technologies with higher energy efficiency compressors with the capability in design and specification for full and partial operating loads. Associated up-gradation of the refrigeration flow control valves, regulation valves, safety valves, pressure relief valves would be included to ensure safer and more efficient management of the plants.

India cold-chain must be future ready and in compliance with environmentally friendly norms as well as be more energy efficient with aim to reduce carbon footprints.

Reference Data Sheet:Compressor *(For Existing and New)*

#	Component: Compressor (For Existing and New)	Description
1	Name of Manufacturer	Name of manufacturer and model number.
2	Type of Compressor	Provide the Type of compressor used.
3	Refrigerant	Provide the technical name of refrigerant.
4	Operating Parameters Suction Temp (°C)/Cond. Temp (°C)	List the Operating parameters for all associated components of the refrigeration that have been taken up under this component.
5	Refrigeration capacity	Provide the Refrigeration capacity of the existing and the new compressor in kW.
6	Power Consumption	Provide the electrical power consumption of the existing and the proposed compressor in kW.
7	Coefficient of Performance	Provide the Coefficient of Performance (COP) as specified by the manufacturer.
8	Capacity control	Type of Capacity control used for part load operation.
9	Motor Rating	Provide the Motor Rating of the existing and the new compressor in kW.
10	Safety cut outs & Gauges	List the Safety cut outs & Gauges available.
11	Total Refrigeration load of facility	Provide existing total refrigeration load in kW

All mandatory rules & regulations (BIS, ISO, IS etc.) relevant to the item must be complied with.

Reference Data Sheet:Evaporator *(For Existing and New)*

#	Component: Evaporator	Description
1	Name of Manufacturer	Specify the Name of manufacturer.
2	Model number.	Specify the model number of the compressor (old/new).
3	Refrigerant	Provide the technical name of refrigerant
4	Refrigeration system	Type of refrigeration system (direct expansion/flooded type, etc.)
5	Type of Evaporator	Attach specification sheet of evaporator
6	Capacity and delta temperature	Provide the Capacity in kW and delta T in degree Celsius.
7	Room temperature °C	Provide the Room temperature being maintained in °C.
8	Air flow	List the air flow in cubic meter per hour (old/new).
9	Volume of chamber	Volume of chamber per evaporator.
10	External Static Pressure	Specify the External Static Pressure (Pa).
11	Power consumption	Provide the electrical power consumption of both the new and the old evaporators in kW.
Valves, Controls and Instrumentation		
12	Control Valves	Provide the type of control valves used in suction line, discharge line, liquid line and defrosting line.
13	Expansion valve	Provide specifications of the expansion valve.
14	Room temperature and RH monitoring	List type of electronic controller used for temperature and RH monitoring.
15	Monitoring and Control	Provide type of electronic controllers and other controls used for monitoring and control of Refrigeration plant

Provide a tabular detail total energy saving in kW from new installation vis old installation. For heat load calculation and guidance on other specifications, the relevant data sheet under cold storage types may be referred to.

Codes and References		
1	IS 660	Safety Code for Mechanical Refrigeration
2	ASME Sec VIII Div 1	Code of Pressure Vessels.
3	ARI /EU	Manufacturing and Testing standards for Refrigeration Compressors
4	Eurovent	European Standards for Evaporators/ Air coolers
5	IS 11132	Ammonia Valves
6	IS 4544	Code of Safety for ammonia
7	IS 3233	Code for Safety and Relief Valves

All mandatory rules & regulations (BIS, ISO, IS etc.) relevant to the item must be complied with.

MODERNISATION OF INSULATION

Component Definition

This component relates to the fixed insulating barrier used in peripheral and intermediary walls, roofs and floor of cold-chain facilities. The component applies to modernising of such insulating medium, where modernising results in a superior thermal barrier, resulting in a reduction in energy loss.

Component Description

The cost norm applicable is 50% of cost incurred, evaluated as per original invoice, with a maximum admissible cost of Rs 100 Lakhs but not more than Rs 1500 per MT of the cold store capacity. This does not limit the cold-chain facility from utilising more insulation as per requirement or from sourcing equipment with other options.

The insulation used should be CFC and preferably HCFC free material with minimal negative impact to the environment. Insulation modernisation must require a change to a more efficient thermal barrier (compare material 'U' values between existing and proposed barrier) to result in at least 5% reduction in energy consumption. In case of cold stores where the existing insulation is older than 20 years, and the facility is operating to commercial capacity, this component can also be availed. Insulation cost will be evaluated at published rates. This component does not apply towards movable barriers such as swing doors, sliding doors, hinged doors and other openings including rubber joints.

All applicable safety norms shall apply to installed insulation.

Remarks/ Recommendations

This component is intended to help existing cold stores to become more energy efficient and reduce their carbon footprint, as part of making the cold-chain more environmentally friendly. This component is not intended to be used to merely replace existing insulation but only where a modernisation of the thermal barrier is justifiable in reducing energy consumption in existing designs. It must be noted that operational cold stores should normally be expected to maintain and upgrade sections of their insulating walls, etc. as normal part of operations. The term modernisation should be taken seriously and should apply to bringing modern more efficient insulation.

Various equipment suppliers offer options in design and specifications which will reflect in the cost of this component. The subsidy is intended to incentivise modernisation of insulation in cold-chain and the beneficiary should be advised not to directly compare the norm with actual chargeable costs.

The insulating capability of a material is measured with thermal conductivity (k). Low thermal conductivity is equivalent to high insulating capability (R-value). In thermal engineering, other important properties of insulating materials are product density (ρ) and specific heat capacity (c). Insulation provides energy efficient, uniform temperatures throughout the space thereby reducing carbon footprints. Unlike heating and cooling equipment, insulation is permanent and does not require much maintenance, upkeep, or adjustment.

The insulation envelope shall be designed to ensure that air pressure created by fans does not affect the integrity of the cold store structure or the panel joints. Existing brick mortar structures may modernise using add-on slabs with appropriate cladding for modernisation.

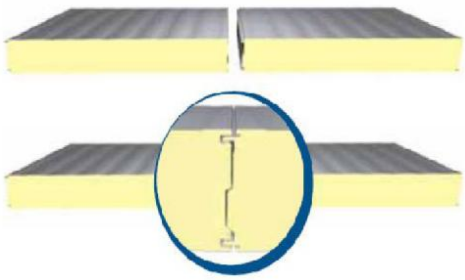
The connecting brackets, bolts, clips and other forms of fixing carry the maximum total loading, which may be imposed, without overstressing or distorting the supporting structural framework or the insulation panels. Non-corrodible hanger assemblies shall be used to support insulating ceiling panels. Exterior insulation is a preferable barrier to prevent heat ingress.

The height of wall panels is often such that care must be taken to ensure that adequate stability of the wall panels is maintained.

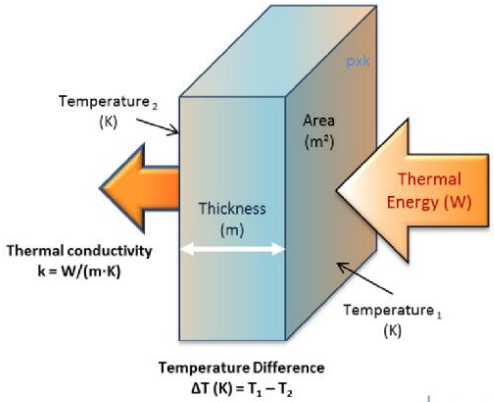
The use of dissimilar metals such as steel and aluminium in contact can cause accelerated corrosion due to electrochemical action and should be avoided.

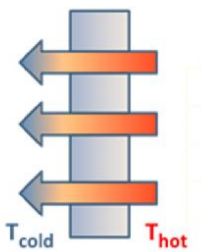
Wind forces can impose excessive stress on an incomplete insulation system and any necessary temporary supports or propping shall be provided.

Suitable walkways, supported by the structural frame, should be provided above the panels.



As technology improves, the avaialbe material range is added. As a standard, instead of the thickness of a specific material, the thermal conductivity and/or U value of the system should be considered and understood. Additionally, care must be taken that no thermal bridges (heat conducting cross penetration) exist. A simple metal bolt, joining the inside to the outside becomes a perpetual energy leak and a point for corrosive action.





$$\frac{Q}{t} = \frac{kA(T_{hot} - T_{cold})}{d}$$

Q = Heat transferred in time = t

k = thermal conductivity of barrier

A = area of barrier

T = temperature

d = thickness of barrier

Material examples	Indicated Thermal conductivity (W/m K)
PUF Composite Panel	0.023
Brick, red	0.6
Aluminium	205.0
Ice	1.6
Glass ordinary	0.8
Concrete	0.8
Water at 20° C	0.6
Asbestos	0.08
Fiberglass	0.04
Brick, insulating	0.15
Cork board	0.04
Rock wool	0.04
Polystyrene sheet	0.033
Polyurethane Foam	0.021
Wood	0.12
Air at 0° C	0.024
Silica aerogel	0.003

Reference Data Sheet: *(For Existing and New)*

#	Composite: Insulation	Description
1	Name of Manufacturer	Name of manufacturer and model.
2	Total wall/ceiling/partition areas	List the surface area of the insulating material used in m^2
3	Floor area	Total floor area of the cold room in m^2.
4	Insulating material and thickness	Provide type of insulating material and thickness.
5	U value	Provide stabilized U value
6	Density	Provide the Density in kg/m^3
7	Thermal diffusivity	Provide the thermal diffusivity in m^2/h.
8	Type of vapour barrier and thickness	List the type of vapour barrier in the insulating material and its thickness in microns
9	Type of skin (if applicable)	Provide the type of skin of the insulating material.
10	Joint type	Describe the type of joints used in the insulation.
11	Fire resistance characteristic	Describe the fire resistance characteristics.
12	Substrate Used (if applicable)	Specify the substrate used.
13	Adhesive to fix with substrate	Adhesive to fix with substrate i.e. the Locking/Fixing and sealing system used.

Codes and References		
1	IS 661	Code of Practice for Thermal insulation of Cold storages
2	IS 12436 - 1988	Specifications for Rigid Polyurethane
3	DIN 55928	Specification of Galvanised steel Cladding
4	EN 13241 -1	Construction of Industrial Doors
5	ASTM D 1622	Density
6	ASTM C 177-97 or ASTM C 518-98	Thermal conductivity
7	ASTM E 96-00	Water vapour diffusion resistance
8	ASTM-E-84	Standard Test Method for Surface Burning Characteristics of Building Materials
9	ISO/FDIS 4898	Thermal Conductivity
10	ISO 9001-2000	Quality Management
11	The National Building Regulations and Building Standards Amendment Act No. 103 of 1977	Building standards
12	FS 3000	Optional food safe surface coating
13	IS : 513, 277 & 14246	Colour coated GI sheet
14	IS: 12436.	Polyurethane Foam
15	IS 801 & 811	Pre-engineered Building
16	AISC-2005	Design Code
17	IBC2006	Building Code
18	DIN EN 13501-1	Classification of behaviour in fire up to Bs1,d0 in accordance with DIN EN 13501-1

All mandatory rules & regulations (BIS, ISO, IS etc.) relevant to the item must be complied with.

REEFER CONTAINER

Component Definition

A reefer container describes a multi-modal insulated container box with integrated refrigeration equipment. Unlike fixed body trucks, reefer containers can be released from the trailer chassis and handled as a unit load or be stationed on site for localised use as a temporary temperature controlled store pending subsequent operations. This allows the prime motive and/or trailer to be utilised for other carriage.

Component Description

A cost norm of Rs 6 lakh per 9 MT (20 foot container) as defined in code ISO/ TC 104, ISO 668:2013, ISO Code 22R1, 45R1 is applied as part of add-on components.

The component name "Reefer Container" is a temperature controlled unit whose insulating body is made of prefabricated insulating panels. The container is designed to be liftable for mounting on or unloading off a carrier-bed and has both forklift and top lift tolerant design. It has one fixed door at the end opposite to the reefer unit. The air transit pattern is bottom-up from floor to ceiling and the floor section is designed to allow air to circulate under the cargo. A fresh air intake system is in-built making it most suitable for horticulture produce.

Reefer container shall be designed for the full range of standard temperatures ranging from -25 degree Celsius to +25 degree Celsius. There shall be provision for temperature recording, capable to program set-point for either supply air or return air. As this equipment is a removable unit on a transport chassis, the corner posts must have locking facility to secure the container on its carrier.

Such container designs are of the same standard use for export and import of horticultural produce by sea and the design is considered optimal for long haul of perishables. All applicable safety norms shall apply to reefer containers.

Remarks/ Recommendations

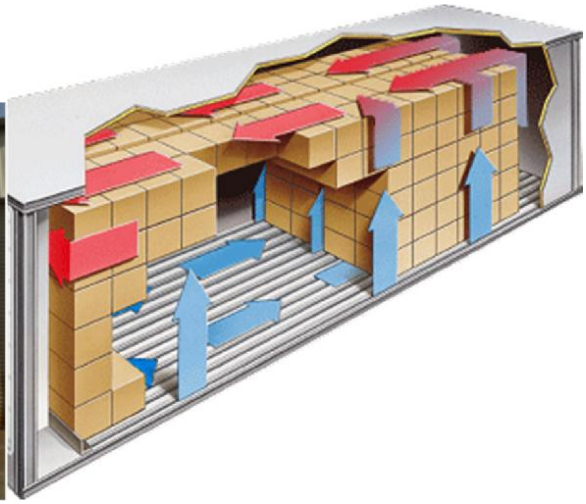
The subsidy is intended to incentivise use of reefer containers in domestic cold-chain and beneficiary should be advised not to view this as an option to procure containers for international haulage.

There are multiple advantages to utilising such reefer containers, some of which are enumerated-

1. Dimensions are optimised for standardised pallet carriage; thereby allowing for standardisation in handling of perishable cargo in cold stores and in transit.
2. Available on demand as prefabricated units (in use globally) and hence is delinked with fabrication (delivery delays) as in case of fixed body reefer trucks.
3. Design incorporates fresh air venting which is necessary for perishable crops under long haul movement, for e.g. Himachal to Bangalore, a road trip of more than 9 days (equivalent to a trans-Atlantic crossing by ship). Venting also helps minimise ethylene build up (fruits and vegetables).

4. Design allows for multi-modal utility – by road / rail / ship. This will help develop and optimise goods movement by rail or coastal shipping without undue handling of goods.
5. Designed for plug-in electricity source and can be used as mini storage at various locations, pending further activity.
6. Refrigerated body can be dismounted / delinked from primary vehicle, freeing the prime motive or vehicle for other gainful work or other carriage options.
7. There are other design aspects that allow for innovative application of this component.

The reefer containers have computerised cooling system controls, enabling precise temperature control which is important in case of long haulage of horticulture goods. The air ventilation port allows for high respiring perishable goods to continue to have life sustaining oxygen, especially when in-transit in enclosed space for longer than 3 days. These ventilation ports are adjustable to suit the varied demand pattern of fresh fruits and vegetables. It must be noted, that lack of oxygen and build-up of respired CO_2 cause demise of horticulture goods when enclosed over long periods.



Photographs sourced from NCCD members

Reference Data Sheet

#	Component: Reefer Container	Description
1	Container dimensions	20 standard: 8’ x 8.5’ x 20’, 27 to 28 cum
2	Insulation details	Thermal Conductivity value / mm
3	Tare weight	kgs
4	Gross weight	kgs

#	Component: Reefer Container	Description
5	Temperature recording	type
6	GPS System	Must be fitted
7	Refrigeration capacity	kW
8	Refrigerant used	Technical name of refrigerant
9	Fresh air exchange	Describe system fitted
10	Diesel/electric auto-switching	Describe dual power unit
11	Air flow cum/hr (CFM)	Evaporator air flow in CFM
12	Temperature control precision +/- °C	Precision in controls in °C
13	Name of Manufacturer	
14	Year of manufacture	
15	Any design enhancement	Describe design changes is any

Codes and References		
1	ISO/ TC 104	Freight containers
2	ISO 668:2013	Classification, dimensions and ratings
3	ISO/NP 1161:1990	Corner fittings
4	ISO 1496/2 : 1996	Specification and testing
5	ISO Code 22R1, 45R1	Size of container
6	ISO 6346: 1995	Coding, Identification and Marking
7	ISO-14001:2004	Environmental Management
8	ISO 1496/2	Performance test of thermal appliances

All mandatory rules & regulations (BIS, ISO, IS etc.) relevant to the item must be complied with.

ADVANCED GRADER

Component Definition

This component refers to a sorting and grading line which incorporates advanced technology such as acoustic and/or optical sensing systems that can segregate produce as per selected criteria of colour, firmness including size and shape.

Component Description

Admissible cost norm applicable is a maximum of Rs 75 lacs for a component of Advanced Grader. This does not limit the cold-chain Facility from utilising more Advanced Grading system as per their requirement or from sourcing equipment with higher costs or options.

The Component name "Advanced Grader" may consist of a complete automated grading solution. The major admissible items under this subsidy component are:

1. Automated grading mechanism (acoustic, optical)
2. Computerisation and associated software.

The automated grading component can be added to existing grading lines or incorporate a complete line based system, depending on the type of technology, handling capacity per hour of operation, type and source of equipment, among others. Capacity optimised grading lines with enhanced technologies should be used, were suitable, by cold-chain operators.

Advanced graders can be appended with specialised packaging line to integrate both components into one utility along with a mechanised sorting grading unit at pack-houses.

Remarks/ Recommendations

Various equipment suppliers offer options in design specifications which will reflect in varied costs of this component. The subsidy is intended to incentivise the use of advanced grading technologies in cold-chain facilities (farm-gate cold stores and pack-houses) and the beneficiary should be advised not to directly compare the norm with the actual chargeable costs.

Depending upon the agro-climatic conditions grading of fruits and vegetables on the basis of physical characteristics like weight, size, colour, shape, specific gravity, and freedom from diseases is an essential step in post-harvest management which enables the segregation of the produce on the basis of their quality requirement and hence enhancing the financial throughput of the produce.

Grading may necessitate 1) Weight Grading in which the fruits must be electronically weighed to seggregate them on the basis of their weight. 2) Colour Grading would involve grading according to the desired colour of the product. 3) Diameter Grading would grade the product on the basis of required sizes. 4) Intelligent Quality Grading grades the product on the basis of the desired quality condition prevailing on the Inner and Outer sides of the product.

Advanced Grader systems should be used to segregate produce for the ensuing supply chain on the basis of marketable value and therefore is viewed as a value multiplier.

Advanced Grader shall be well designed for optimal peak throughput and ensure operational efficiency as per relevant norms.

Reference Data Sheet

#	Component: Advanced Grader	Description
1	Produce	List the type of produce to be handled.
2	Weight Sorting/ Grading	Does the equipment have electronic weighing.
3	Colour Sorting/ Grading	Can the equipment grade/sort the product on the basis of desired colour, Capable of sorting by average colour or background colour or blush.
4	Optical/Acoustic Diameter Grading	Is the equipment with a high resolution camera so that size of each fruit/vegetable is measured accurately.
5	IQS (Intelligent quality Sorting/ Grading)	Can the fruit/vegetable be automatically sorted /graded by quality taking into account the outer and inner condition of the product.
6	Safety Precautions	Equipment must incorporate emergency stops and other statutory safeguards
7	Output capacity	Describe in units per hour or ton per day
8	Power consumption	kW for each hour in operation
9	Name of manufacturer	
10	Year of manufacture	

All mandatory rules & regulations (BIS, ISO, IS etc.) relevant to the item must be complied with.

Refer MIDH OPERATIONAL GUIDELINES- APPENDIX II (XIII)

STACKING SYSTEM

Component Definition

This component refers to storage mechanism such as racks, bins and pallets for holding unitised cargo in storage and transport. These are constructed with metal, plastic, wood of specifications suitable to temperature controlled conditions.

Component Description

The cost norm applicable will be up to a maximum of Rs 2000 per metric tonne of storage capacity for assistance and incentive for procuring of modern storage units like bins, pallets and racks for existing and new cold stores.

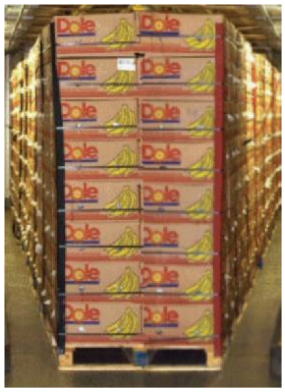
The component "Stacking System" comprises of following:

1. **Pallets:** fork lift handled base platform on which packaged produce can be stored in unit loads up to 2.1 meter height and a total load of 1 ton. These are normally constructed in standard dimensions and allow for multi-tiered racked storage.
2. **Bins:** fork lift handled storage boxes with capacity handling up to 3 tons load per box. These are constructed with a nesting design to allow direct over stacking, one atop the other. The usage is for non-package bulk storage.
3. **Racking**: multi-tiered framework, usually of coated metal, designed to store unitised cargo loads. The engineering design defines the total safe load and racking stress the strut based structure can tolerate. This kind of storage system allows for multi-product usage under compatible temperature conditions in common chambers.

Remarks / Recommendations

The concept behind introducing the stacking system as a subsidy component is to promote standardisation in load handling and is brings storage space in synergy with modern packaging systems. Palletisation of loads, in particular, facilitates mechanised handling and helps to reduce the handling damages in the cold chain. Such system also harmonises the cold-chain with global practises and standards, which will help associated trade (exports).

Unit load handling is optimally done with motorised or manual fork lift handling equipment and therefore facilitates speedier handling. This is helps to minimise temperature excursions in the cold-chain that occur during loading and unloading - the weak links in the cold-chain.

Pallets and Rack system

Wooden Bins

Representative Photographs

Reference Data Sheet

#	Component: Stacking System	Description
A	**Bins**	
1	Name of Manufacturer	Provide the name of manufacturer
2	Material of construction	Provide the material of construction of the bins.
3	Load capacity	Carrying Load capacity in kgs.
4	Storage volume	Provide the volumetric dimensions (L x B x H) of bin
5	Stacking Height	Maximum stacking height as indicated by the manufacturer.
B	**Pallets**	
1	Material & working load	Material of the pallet and load bearing capacity (kgs/tons).
2	Dimensions	Provide the Dimensions in (L x B x H) mtrs.
3	No of cartons per pallet	Total number of boxes per pallet and weight per box.
4	Type of access	Specify if two way/four Way fork access available
C	**Racking System**	
1	Name of Manufacturer	Name of manufacturer
2	Type of racking system	Selective/double deep/drive-in/automated/etc.
3	Design Overview of rack	Attach plan and cross-sectional view of the racking system.
4	Material of construction	Material of construction, and cross sectional strength
5	No of tiers	Specify the tiers of storage.
6	Net storage capacity	Specify the net storage capacity in MT.
7	Load bearing weight per position	Specify the safe loading weight per position.

Codes and References		
1	ISO 9001	Quality Management System

All mandatory rules & regulations (Building codes as per seismic zone, BIS, ISO, IS etc.) relevant to the item must be complied with.

RETAIL SHELF

Component Definition

The Retail Shelf equipment's are temperature and/or humidity controlled cabinets or shelves that help in merchandising of fresh horticulture produce by maintaining the on-shelf quality of fruits and vegetables.

Component Description

A maximum admissible cost norm of Rs 10 lac per establishment is applicable for a Retail shelf as part of add on components for credit linked subsidy. This does not limit the establishment from utilising more retail shelves as per requirement or from sourcing equipment with higher costs or options.

The Component name "Retail Shelf" can consist of individual items such as:

1. Multi-decks
2. Small Multi-decks
3. Roll In decks
4. Vertical Decks
5. Specialised cool shelving
6. Associated refrigeration and humidification equipment.

All applicable safety and performance norms shall apply to Retail Shelf component.

Remarks/ Recommendations

Various equipment suppliers offer options in design specifications which will reflect in the cost of this component. The subsidy is intended to incentivise use of Retail Shelves in the cold chain and beneficiary should be advised not to directly compare the norm with actual chargeable costs.

Retail Shelves should be used to retain the quality and enhance marketability of the produce. These temperatures controlled Retail Shelves shall be well designed for optimal peak load and ensure operational efficiency as per norms.

Multiple units per establishment can be ordered. The floor area per establishment should be sufficient to leave aisle space and emergency exits after installing the equipment. It is preferable that the out-door unit is installed clear of external disturbance, where this option is used.

The retail establishment should preferably have an enclosed space where these temperature controlled display units are being installed.

At the last mile of the cold-chain, strengthening the retail segment with technology options will also help generate consumer demand for quality fresh produce in optimal packaging, with traceability systems and with higher nutritional value. Support to modernise street merchandising carts is also provided under the guidelines.

Representative Photographs from www

Reference Data Sheet

#	Component: Retail Shelf	Description
1	Name of Manufacturer	Provide the name of manufacturer and model.
2	Type	Specify the kind of Retail Shelf i.e. Multi-decks, Small Multi-decks, Roll In's.
3	Produce to be handled	Name types of produce to be handled
4	Capacity	Storable volume of fresh products the shelf can store in m^3.
5	Dimension external	Specify the floor area occupied by the retail and height in mtr
6	Electronics	Specify energy saving electronics and the automatic cut-off/start are provided.
7	Temperature Range	Specify the operating Temperature Range of the Retail Shelf as specified by the Manufacturer.
8	RH control	Provide details of RH controls
9	Lighting system	Provide details and kW of lights used
10	Total Refrigeration capacity	Provide the capacity of refrigeration unit of the shelf in kW.
11	Refrigerant used	Provide the technical name of refrigerant.
12	Energy consumption	Total power consumption of the shelf in kW.
13	Years in business	Provide details of retail shop, years in business, annual sales volume, etc.

All mandatory rules & regulations (BIS, ISO, IS etc.) relevant to the item must be complied with.

ALTERNATE ENERGY OPTIONS

Component Definition

This component includes various alternate energy options such as a renewable energy source, thermal energy banks or other non-conventional technologies that can be used to operate the equipment or serve as an energy buffer at a cold chain facility. Individual alternate energy options and their associated components that are necessary for a complete solution are included under this component.

Component Description

Under MIDH norms a beneficiary may apply for a maximum cost of Rs 35 lacs for any of the listed items or a combination thereof. The cost norm does not limit the cold-chain facility from deploying more alternate energy options as per individual requirement or from sourcing equipment with higher costs or options.

The Component name "Alternate Energy Options" can consist of Solar PV systems, Solar Thermal systems, Thermal Banks of Phase Change Material or Eutectic based systems, Vapour Absorption based chilling systems, etc. The admissible items under this subsidy component include:

1) **Solar PV Systems** for generating power as an installed aggregate of solar photovoltaic arrays (panels) made of solar photovoltaic cells, inverters, batteries and cabling. This comprises individual items such as:
    a. **Solar PV Panels** that convert solar radiation into electricity.
    b. **Inverters** with the ability to convert the current generated in the solar panels into AC form, inverters should be able to synchronize the output with the utility voltage and frequency.
    c. **Battery** utilized for the purpose of storing energy should be specialized solar batteries of the approved type.
    d. **Wiring & miscellaneous Electrical Components** consisting of wires and connectors typically used for PV systems.

Design and specifications of component items to be in compliance to the MNRE published guidelines.

2) **Solar Thermal System** is an installed aggregate of solar collectors for receiving the solar irradiance, hot water storage tank(s) with pipelines, controls and motors for hot water. This Includes individual items such as:
    a. **Solar Collectors** to collect the heat of the solar radiation to heat the water.
    b. **Storage Tank** to effectively store the heated water, insulated to counter energy losses.
    c. **Integrated Piping** for the interconnection of the solar collectors and connection of storage tank to outlet.
    d. Solar thermal systems may also deploy energy banks to store heat overnight or for long durations.

Design and specifications of component items to be in compliance to the MNRE published guidelines.

3) **Thermal Banks** are technology solutions based on phase change material or other thermal energy storage materials that effectively store and release energy on demand and primarily to serve as a buffer against breaks in electrical energy sources. Phase change materials can be understood as controlled ice which releases cooling at a desired temperature, when undergoing a phase change from solid to liquid form. The material used in thermal banks store or release large amount of latent energy when the material changes from solid to liquid and vice versa.

   Solutions designed to utilise this latent thermal inertia are commonly used as "Ice Lined Refrigerators" for storage of vaccines. Similar solutions can be developed to leverage solar thermal energy or grid electricity for use in cold-chain utilities. Such options are also used in reefer transports, merchandising equipment, short term transport boxes, cool buffer to supply cold air in cold rooms in case of mains power failure, storing sun's heat for post-harvest drying process, blanching or warm washing prior to other processes, utilising to drive vapour absorption refrigeration, etc.

4) **Vapour Absorption Refrigeration** is an alternative to the conventional and more common vapour compression refrigeration technology. A vapour absorption machine is a refrigeration system that uses a heat source (e.g., solar, bio-mass-fuelled flame, waste heat from other utilities, etc.) to drive the cooling system. In this case, the prime refrigerant does not go through a mechanical compressor, but utilises the heat energy to generate the necessary vapour pressure before the condensation and expansion phase of refrigerant based cooling. The fact that solar thermal energy can be used to run refrigeration system makes this technology future ready and environment friendly. In vapour absorption systems, a refrigerants-absorbent pair is used. The most commonly used refrigerant-absorbent pairs in commercial systems are:

   a. Water-Lithium Bromide (H2O-LiBr): In this system water is the refrigerant and lithium bromide is the absorbent.
   b. Ammonia-Water (NH3-H2O): In this system ammonia is the refrigerant and water is the absorbent.

This technology and combinations thereof with other options, provides scope to generate endless cooling with the primary energy source being waste heat or free solar energy.

Other alternate technologies in cooling can be submitted under this component for due consideration.

Alternate technology options can also include geothermal based cooling systems, hybridised solutions that utilise multiple technologies (combining conventional and non-conventional), and other innovative options. Support under this component shall be on a case to case basis and appraised in collaboration with experts / Ministry of New and Renewable Energy.

All applicable safety and performance norms shall apply to installed equipment. The technology used should be fully functional and contribute towards the concept of greening of India's cold-chain.

Remarks & Recommendations

The concept behind introducing this component is to provide scope for alternate energy options and promote innovation in the energy intensive phase of cold-chain operations. The outcome will be two fold, the first is to allow India's cold-chain to maintain a lower carbon footprint and the second is in alleviating risks and costs that arise off intermittent grid power. Various design options shall be frequently shared by NCCD in its publications.

Various equipment suppliers offer options in design specifications which will reflect in the cost of this component. The subsidy is intended to incentivise use of 'Green Energy' alternatives in the cold chain and beneficiary should be advised not to directly compare the cost norm with actual chargeable costs.

About Solar PV:
A Solar Photovoltaic system comprising of solar photovoltaic cells converts light energy into electricity in the form of DC current, the generated power is either stored in batteries in the DC form or converted to AC form using an inverter and then supplied through the cabling to interconnect with the utility.

Solar Photovoltaic systems can be used to reduce the operational cost of the facility by utilising the electrical energy generated for captive use of the facility. In such cases, the Solar PV system shall be designed for optimal peak loads connected to the system. The installation will include a battery bank to store the electrical energy for use on demand. An inverter system is necessary to convert the stored DC into AC for use.

Solar PV arrays can also be used as a grid interactive system, with the electricity generated being fed into the grid. In this case, there may be no need to install batteries, and a meter is used to measure the quantum of energy supplied into the grid. A safety system is necessary to disconnect the system from grid when necessary. This operational model allows for the facility to have an alternate revenue stream with the aim to offsets the energy cost of operating the facility.

About Solar Thermal
A Solar Thermal system comprises of solar collectors of Flat-plate type or Evacuated-Tube-Glass type to absorb solar light energy in the form of heat. This energy is usually stored in form of heated water in insulated tanks for subsequent use. Thermal banks in the form of encapsulated phase change material can also be incorporated to store the heat for longer durations. The heat generated can be used for blanching, drying processes as well as the energy source to operated refrigeration cooling systems.

Solar Thermal systems should be used to reduce the operational cost of the facility and to enhance its operational capabilities.

More advanced solar thermal systems are also an option, utilising concentrated solar thermal technology to generate and store very high thermal energy.

About Phase Change Material
A PCM changes its phase from solid to liquid and vice versa and during this process is capable of storing or releasing the energy required for this process, thus this stored or released may be utilized for fulfilling other requirements. Phase Change Material in combination with other options can be used to store heat (cold) energy for subsequent use; much like a battery is used to store electrical energy.

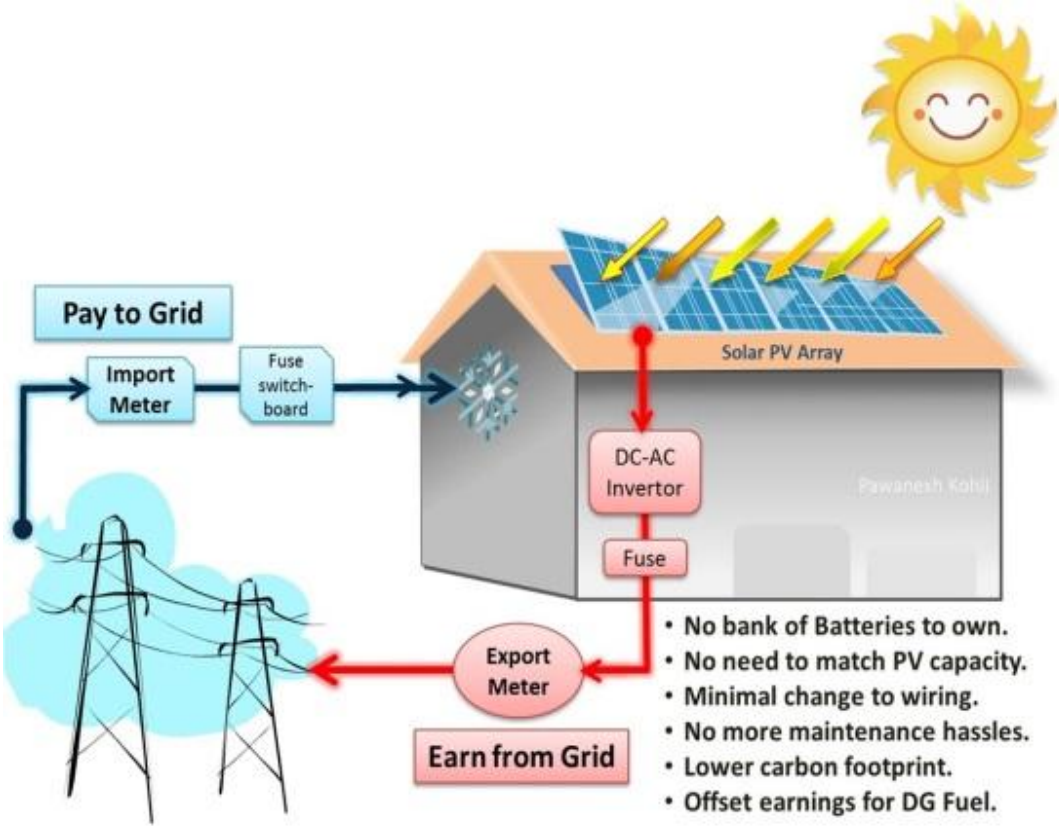
Depending on the mass and temperature required, a well-designed system can serve as thermal backup from a few hours to more than a day.

Thermal Banks utilising PCM and similar material should be used to reduce the operational cost of the facility and adopt greener technologies.

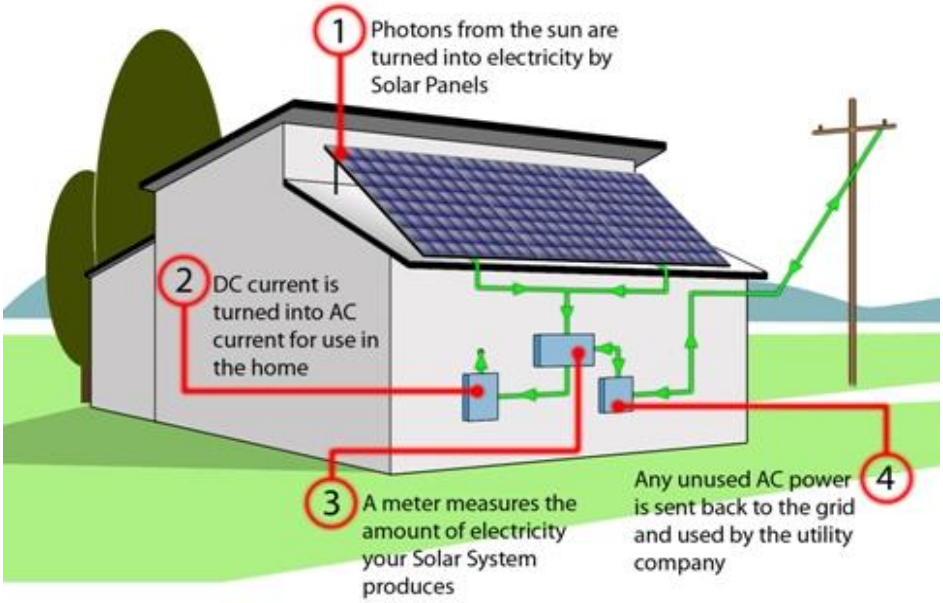
About Geo-thermal cooling

The earth is typically 10°C to 20°C cooler than the ambient, especially in summer months. A few meters below the surface, the temperature can remain in the range of 20°C to 23°C all through the year and this can be tapped into to bring down cooling load in various ways.

A simple design would be to use solar powered pumps to circulate cool underground water in a closed loop to cool down the ante room of cold store facilities. Similarly, innovative designs can be used to moderate very cold temperatures in winter months, especially in case of horticulture crops that need to be maintained at mid chill temperature ranges.

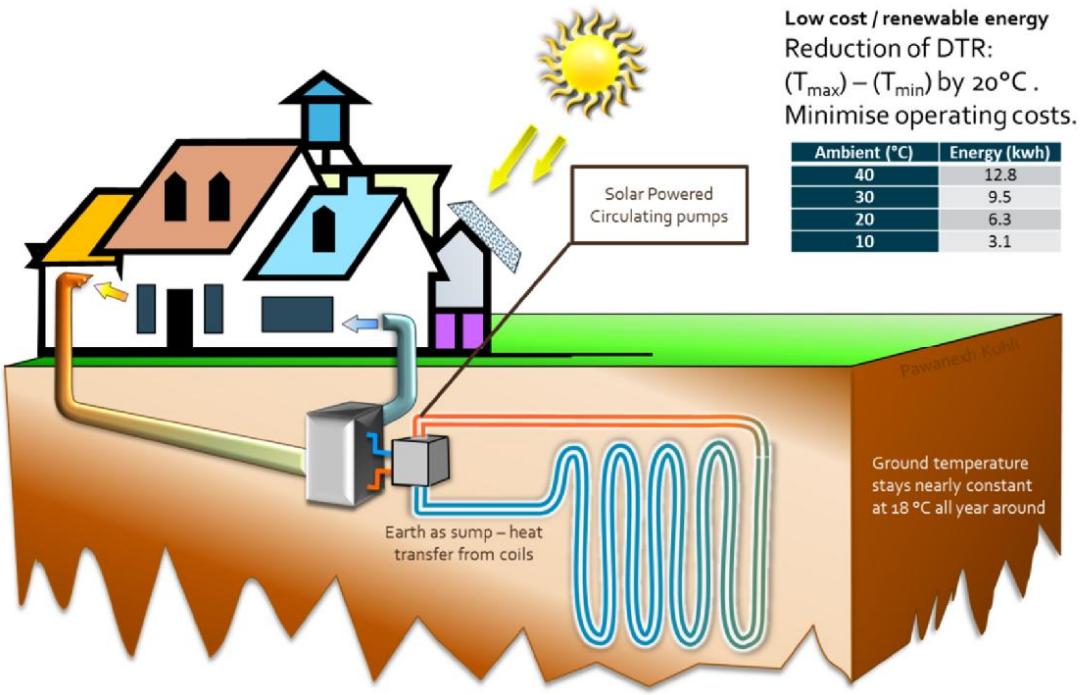


Solar Panels as grid interactive system – revenue generating model.



Visualisation of Solar Panel as energy source – for captive consumption

Small Cold-store with Solar Panels for captive use.

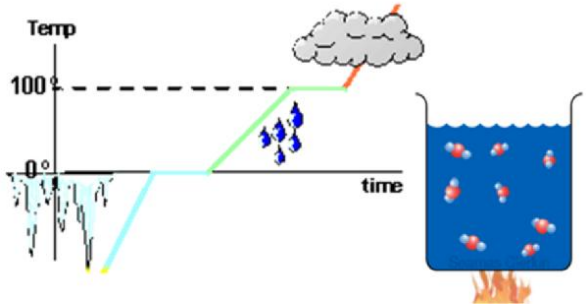


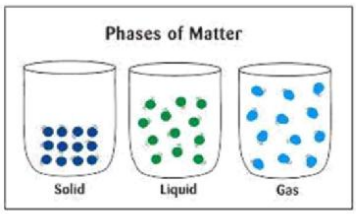
Using Geo-thermal energy in facilities

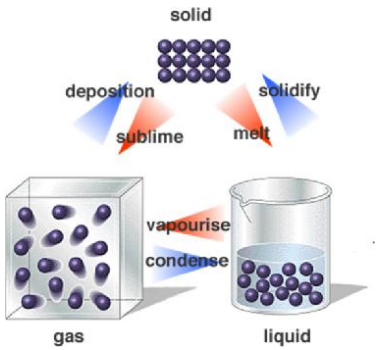
Thermal Storage

- The tendency to retain or resist any energy level change.
- Maintains a desired steady state temperature profile.
- Energy stored and output from 170 KJ to 300 KJ per kg.
- Offers innovation options in a wide array of thermal applications.

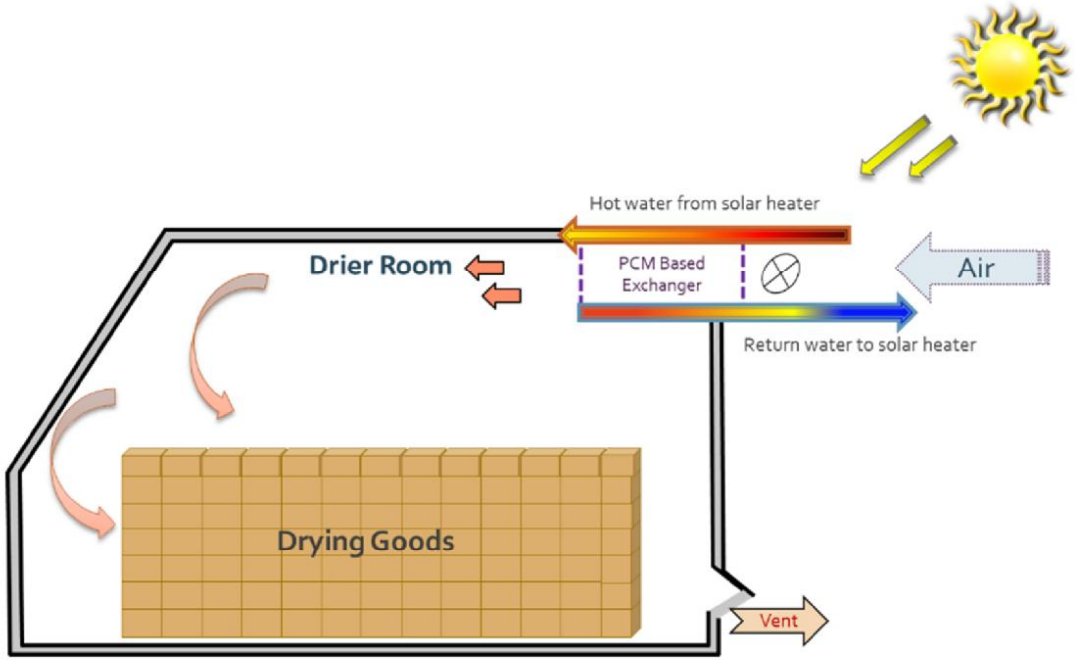
- When water freezes, energy is released to surroundings.
- When ice melts, energy is absorbed from surroundings.
- PCM is 'ICE' at controlled, desired temperature levels (example: ice that melts at +20 °C)







Thermal storage concept.



- PCM bank serves as a thermal 'battery'.
- Continuance in heat transfer and to drying process.
- Low cost energy source, renewable.

PCM uses in drying rooms and in Cold transport

Type	Phase Change temp °C	Contents	Operating Temp °C	Density (kg/m3) Liquid	Latent Heat (kJ/Kg)	Flammability	Qty per kWh (kg)
Negative	-26	Inorganic Salts	-25 to -26	1280	205	No	23
Negative	-23		-22 to -24	1180	210	No	18
Negative	-19		-17 to -21	1170	200	No	18
Negative	-7		-7 to -5	1120	230	No	16
Frost	0		-1 to +1	1010	300	No	12
Positive	22		21 to 23	1540	185	No	19
Positive	24		23 to 25	1540	185	No	19
Positive	29		27 to 29	1550	190	No	19
Positive	58		57 to 59	1290	250	No	15
Positive	89		87 to 89	1540	180	No	20

Sample Reference Data Sheets

SOLAR PV Installation

#	Component: Solar Photo Voltaic (SPV)	Description
1	Name of Manufacturer	Provide name of manufacturer.
2	Make and model no.	Provide the make and model number.
3	Total shadow free area, total area occupied by PV panels	List the shadow free south facing area and total area occupied by PV panel in m^2.
4	Loads to be energized	Provide the details of loads to be energized if any – not necessary when linked to grid.
5	Storage battery capacity	Provide total battery capacity that shall be used to store the energy generated in Amp-hours, if applicable
6	Battery Backup	Provide the battery backup in hours.
7	Grid interactive	Provide grid metering rate for facility.
8	Energy generation	Provide the expected annual/monthly energy generation in kWh.

#	Component: Solar Photo Voltaic (SPV)	Description
9	Grid Electricity Availability	State number of hours electricity is available at the facility.
10	Total SPV Capacity	Provide the SPV (Solar Photo Voltaic) capacity in kW.
11	Power of single PV panel and total number of panels installed	Specify the power in watts of single PV panel and total number of panels installed.
12	Total array size	Specify no of PV panels in a single array.

#	Codes and References : Solar PV	
1	IEC 61215/ IS14286 IEC 61646/Equivalent IS	Thin Film / Crystalline Silicon Terrestrial PV Modules
2	IEC 62108	Concentrator PV Modules & Assemblies
3	IEC 61730	Part 1- requirements for construction & Part 2 - requirements for testing, for safety qualification or Equivalent IS (Under Dev.)
4	IEC 61701 / IS 61701.	Salt Mist Corrosion Testing for working in coastal highly corrosive areas
5	IEC 61683 / IS 61683 IEC 60068-2 (1, 2, 14, 30)/ Equivalent BIS Std.	Power Conditioners/ Inverters**including MPPT and Protections
6	IEC 60227 / IS 694 IEC 60502 / IS 1554 (Pt. I & II)	General Test and Measuring, Method PVC insulated cables for working voltage up to and including 1100 V and UV resistant for outdoor installation
7	IEC 60947 part I,II, III / IS 60947 Part I,II,III EN 50521	General, Requirements, Connector, safety, A.C. /D.C. (Switches/Circuit Breakers /Connectors)
8	IP 54(for outdoor)/IP21 (for indoor) per IEC 529	General Requirements for Junction Boxes /Enclosures for Inverters/Charge Controllers/Luminaries

All mandatory rules & regulations (MNRE, BIS, ISO, IS etc. standards) relevant to the item must be complied with.

SOLAR THERMAL: Sample Data sheet

#	Component: Solar Thermal	Description
1	Name of Manufacturer	Provide the Name of the manufacturer.
2	Make and Model No.	Provide the make and model number.
3	Type of System	List the type of System i.e. if FPC/ETC/Concentrating type.
4	Capacity	Provide the Capacity in hot water litres per day.
5	Type of Tank material and thickness	Provide the make of hot water tank i.e. S.S/M.S/other material and also its thickness.
6	Insulation material and thickness (mm)	Specify the thickness of insulation.
7	Heat Exchanger Available	Specify if Heat Exchanger is available and the type of method for heat exchange
8	Total number of collector panels	List the total number of collector panels.
9	Dimension per collector panel (l x w)	Provide the dimensions per collector panel.
10	Total Area Covered by collector	List the Area Covered by the collector in m^2.
11	Open Loop/Closed Loop System	Specify if direct heating of tank water or indirect heating.

#	Codes and References: Solar Thermal	
1	Flat Plate Collectors	ISI mark (2 sq. m. absorber area for 100 litre tank capacity system in colder region and 125 litre for other regions)
2	Evacuated Tube Collectors/ Heat pipes / Supplier name	Type of tubes = 3 layer solar selective (Inner layer of copper coating should be visible). Detailed specifications of tubes will be as per the guidelines laid down by MNRE. Supplier to be MNRE empanelled. No. of tubes in a system= Number of tubes X Radius in Meter X Length in Meter
3	Storage Tanks	Inner tank material- SS 304 or 316 grade min/ MS or any other material with anticorrosive coating for hard water with chlorine contents. Inner tank thickness- For SS minimum thickness will be 0.5 mm when using argon arc or metal inert gas for welding and 0.8 mm when using other type of welding. For MS minimum thickness will be 1.5 mm. No leakage under any kind of negative or positive pressure of water will be ensured. Inner tank welding- TIG / Seam/ pressurized weld (Open arc weld not permitted)
4	Thermal insulation of tanks & Hot water piping	Minimum 50mm thick with CFC free PUF having density Tanks & hot water piping of 28-32 kg per cum. For regions with sub-zero temperatures, it will be doubled.
5	Outer cladding & Frames	Al/SS/FRP or GI powder coated. MS may also be used with special anti-corrosive protective coatings
6	Valves, cold water tank: vent pipe, heat exchanger, make up tank & measuring instruments	ISI mark or standard make

All mandatory rules & regulations (MNRE, BIS, ISO, IS etc. standards.) relevant to the item must be complied with.

THERMAL BANKS: Reference Data Sheet

#	Components: Thermal Banks	Description
1	Name of System Provider	Specify the name of system provider
2	System design	Describe the design details.
3	PCM material	List the phase change material used.
4	Phase change Temperature and latent energy	Indicate at what temperature (°C) phase change occurs and latent energy (kW)
5	Application	Describe the planned use of the system.
6	Backup period	Provide the backup period in hours.
7	Mass of PCM	List the amount of PCM used in Kg or tons.
8	Total Thermal Energy Bank	Provide the total capacity of thermal energy bank in kW.
9	PCM encapsulations	Provide details of encapsulations.
10	Time to fully Charge the PCM	Provide the time needed to fully Charge the PCM Bank.
11	External energy input	Describe and provide specifications of the external energy input.

All mandatory rules & regulations (BIS, ISO, IS etc.) relevant to the item must be complied with.

VAPOUR ABSORPTION: Reference Data Sheet

#	Component: Vapor Absorption	Description
1	Name of Manufacturer	Provide the name of manufacturer.
2	Make and Model No.	Provide the make and model number
3	Capacity	Provide the total capacity in kW.
4	Refrigerant used	Provide the technical name of refrigerant
5	Absorbent used	List the absorbent used i.e. Lithium bromide/water/etc.
6	Temperature of Chilled water	Provide the temperature of chilled water in/out in ^{o} C.
7	Temperature of hot water	Provide the temperature of hot water in/out in ^{o} C.
8	Temperature of condensate	Provide the temperature of the condensate in/out in ^{o} C.
9	Describe heat Source & heat energy	Specify the heat source/heat energy used in k W-i.e. Solar, bio-mass-fuelled, waste heat from utilities, etc.
10	Inlet/outlet Pressure drop	Provide the inlet/outlet Pressure drop in kPa.
11	Electrical Consumption	Provide the total electrical consumption in kW.
12	Type of vapor absorption machine.	Specify whether single fired or double fired.
13	System use	Describe total load required and application of this system.

All mandatory rules & regulations (BIS, ISO, IS etc.) relevant to the item must be complied with.

REFRIGERATED TRANSPORT

Component Definition

This component refers to Reefer Trucks – vehicle road transport with fixed insulated carriage body equipped with active refrigeration designed for temperature controlled carriage of horticulture produce. All refrigerated trucks supported under these guidelines must incorporate GPS based location tracking system and be installed with data logging temperature and humidity sensors. Varied vehicle capacities and sizes are supported.

Component Description

The cost norm is applicable for vehicles of multiple carriage capacity vehicles. The vehicle's dimensions are currently not standardised and various manufacturers supply differing size and capacity.

For the purpose of these guidelines, 3 cubic metres (106 cubic feet) of internal carriage space is considered equivalent to 1 metric tonne storage capacity, irrespective of mass of goods carried.

A reefer truck must comply with all relevant rules and regulations in its manufacture and operations. A reefer truck comprises of the following-

1. Truck chassis with motive tractor and cabin with an Insulated chamber for reefer cargoes.
2. Insulated Doors with door securing and sealing system
3. Independently fuelled Refrigeration equipment with sufficient air flow depending on size of chamber. Reefer unit should be operable with dual power source.
4. GPS tracking enabled and data logging system to monitor humidity and temperature. At least four data loggers must be supplied with each vehicle.
5. Associated refrigeration monitoring and controlling panel.

Refrigerated trucks of load bearing capacity of 15 MT and above shall be supported by National Horticulture Board. Smaller capacity vehicles shall be supported through State Horticulture Missions. Vehicles of less than 4MT capacity (>12 m^3 space) are normally not suitable for active refrigeration as the carriage space further reduces. However, new technologies allow this option and a case to case appraisal can be undertaken for these sizes.

There is no cap on the total number of vehicles but the transport must serve horticulture produce on at least one leg of its trip.

Remarks/ Recommendations

Various equipment suppliers offer options in design specifications which will reflect in the cost of this component. The subsidy is intended to incentivise use and promote refrigerated road transport to close the gap in the cold-chain. Larger truck capacities are preferred for long haul transport. Care must be taken to ensure that other necessary parameters for safe carriage of horticulture produce are designed.

Reefer containers as an add-on component are unit load units that can be used on multi-modes of transport and must not be confused with this component which is a complete refrigerated vehicle permanently mounted with a complete insulated and refrigerated chamber.

The extant guidelines, standards and data sheets, as published by NHB on behalf of Department of Agriculture and Cooperation, for cold storage projects have been incorporated.

#	Component: Refrigerated Transport	Description
A	**Truck Details**	
1	Chassis number	Provide the chassis details.
2	Make and Engine Model	Provide the make and engine model number.
3	Engine power	Provide the power of prime mover engine in kW.
4	Rated Payload	List the carrying capacity of vehicle in tons.
5	Outer dimensions	Provide the (L x B x H) m of the outer dimension of vehicle.
6	Cabin details	Describe the details of the cabin - sitting, sleeping and driver comfort.
7	Total number of tyres	List the total number of tyres of the refrigerated transport used.
B	**Insulated Container**	
8	Manufacturer name	Provide the name of manufacturer
9	Insulating material and cladding	Type of cladding, insulating material along with its U-value and thickness
10	Internal / External Dimension of insulated box	Provide the internal/external dimensions of insulated box.
11	Flooring details	Describe the details of the floor section (T-section, U-section etc.)
12	Weight of insulating box	Provide the weight of the insulating box in kgs.
C	**Refrigeration Unit**	
13	Maker and Model number	Provide the make and model number.
14	Refrigerant used	Provide the technical name of refrigerant.
15	Refrigeration capacity	Provide the refrigeration capacity in kW.
16	Defrosting system	Provide details of defrosting system used.
17	Air flow and pattern	Air flow in cubic meter per hour and flow pattern (top-down, bottom-up)
18	Total power consumption	Provide the total power consumption in kW.
19	Diesel/electric auto-switching	Specify the Diesel/electric auto-switching mechanism.
D	**Data logging / GPS**	
20	Data loggers	Type and number of data loggers / recording capability
21	GPS	Maker and model of GPS unit.

Codes and References		
1	ISO/ TC 104	Freight containers
2	ISO 668:2013	Classification, dimensions and ratings
3	ISO/NP 1161:1990	Corner fittings
4	ISO 1496/2 : 1996	Specification and testing
5	ISO Code 22R1, 45R1	Size of container
6	ISO 6346: 1995	Coding, Identification and Marking
7	ISO-14001:2004	Environmental Management
8	ISO 1496/2	Performance test of thermal appliances

All mandatory rules & regulations (BIS, ISO, IS etc.) relevant to the item must be complied with.

Refer MIDH OPERATIONAL GUIDELINES- ANNEXE V (C10), ANNEXE VII (A3)

RIPENING CHAMBERS

Component Definition

These are one of the last mile facilities in the cold-chain, designed to function for controlled and hygienic ripening of fresh fruit. Modern ripening facilities are used extensively for ripening bananas but are also used to ripen other fruits like mangoes, avocadoes, kiwis, tomatoes, stone fruit, pears, etc.

Component Description

A ripening facility includes multiple chambers comprising as following-

1. Insulated chambers designed for short term storage under mild chill (16 to 25°C) temperatures.
2. Independent refrigeration equipment to maintain mild chill temperatures for ripening.
3. Ethylene or other FSSAI approved ripening dosing system, usually piped to share across multiple chambers.
4. Air flow designed to allow for even spread of dosing gas, temperature control and ripening in the chambers. Associated air freshening or ventilation system.
5. Material handling equipment for handling incoming and outgoing loads.
6. Electrical control panel(s) to monitor and control the ripening process.

For the purpose of these guidelines, 11 cubic metres of storage space is considered equivalent to 1 metric tonne ripening capacity. A cost norm of Rs 1 lakh per MT is applied for ripening chambers.

Ripening chambers can be designed for multi-tiered pallet based storing or structures for basic storage. The standard cost norm need not uniformly apply across all designs and appraisers must consider actual design and structure type before recommending appropriate subsidy.

Remarks/ Recommendations

Modern ripening is a component important to promote as unsafe ripening practises can cause various health complications to end consumer. Ripened fruit should not be stored for extended duration and should be kept separate from other fresh produce. After ripening, the fruit is ready to be consumed as the produce life cycle is drastically reduced.

The recommended standards published by NHB (NHB-CS-Type-04) on behalf of Department of Agriculture and Cooperation serve as good example for entrepreneurs to use as a guideline for designing a ripening facility and for submitting proposals.

Reference Data Sheet

#	Component: Ripening Chamber	Description
A	**Capacity Details**	
1	Holding Capacity	Provide holding capacity in MT.
2	Room Volume	Provide the volume of room in m^3.
3	Room Size	Provide the size of room (L x B x H) in meters.
4	Number of ripening rooms	List the number of ripening rooms.
5	Peak ambient temperature	Provide the ambient temperature in °C
B	**Pallets**	
6	Size of pallets	Provide the pallet size (L x B x H) in mm.
7	Size of crate/box	List the size of crate/box in mm.
8	Crates/boxes per pallet	List the number of crates/boxes per pallet.
9	Pallets in each chamber	List the pallets in each chamber.
10	No. of tiers	Specify whether single or two tier system.
11	Pallet Lifting System	Specify whether hand pallet or fork lift.
C	**Ripening Parameters**	
12	Ripening room temperature	Provide the room set temperature for ripening in °C
13	Relative Humidity	Provide the relative humidity in percentage.
14	CO_2 concentration	Provide the PPM concentration of CO_2 in ripening chamber.
15	Ethylene concentration	Provide PPM concentration of ethylene in ripening chamber.
16	Product incoming temperature	Provide the incoming temperature of the product in °C
17	Pull down period	Provide the pull down period in hours.
18	Air flow	Provide the air flow in CMH.
D	**Insulation details**	
19	Walls, ceiling and partition.	Describe the material, thickness and U-value.
20	Floor type	Describe the material, thickness and U-value.
21	Exterior wall construction	Describe the material and type of wall construction.
E	**Doors**	
22	Size of door (L x W) mm	Provide the size of door in mm.
23	Type of door used	Specify whether Hinged/sliding/Sectional overhead doors.
24	Number of doors	List the number of doors used.
25	Emergency Measures	List the safety provision provided in case of emergency.
26	Gasket	Provide the type of gasket seals used.
F	**Refrigeration load**	
27	Estimated refrigeration load per chamber	Provide the estimated refrigeration load per chamber.
28	Total refrigeration load	Provide the total load in kW.
G	**Refrigeration system**	
29	Refrigerant used	Provide the technical name of refrigerant
30	Refrigeration system	Describe the type of refrigeration system used.
31	Refrigeration capacity	Refrigeration capacity in kW. and total numbers of condenser
32	COP of refrigeration system	Provide the COP of the refrigeration system used.
33	Evaporator/ condenser details	Provide details-Type, capacity, deltaT of coil to room temp etc.
34	Air flow	Provide the air flow of evaporator in CFM.
35	Static pressure and fan rating	Provide the static pressure of evaporator (Pa) and fan rating (kW).
36	Manufacturer name	Provide the name of manufacturer.
H	**Ripening system**	
37	Ethylene applicator	Maker name
38	Number of cylinders and	Provide the number of cylinders and its capacity per cylinder.

#	Component: Ripening Chamber	Description
	capacity per cylinder	
39	Portable/ Centralized	Provide the type of ethylene generator.
40	Type of controller and Ethylene ppm range	Specify the type of controller and ppm range of ethylene.
41	CO_2 exhaust system	Provide the CO_2 exhaust system details.
42	Humidifier system details	Details of the humidifier used.
I	**Others**	
43	Lighting load	Provide the lighting load in kW.
44	Refrigeration load	Provide the total refrigeration load in kW.
45	Total facility power consumption	Provide the total facility power consumption in kW.

All mandatory rules & regulations (BIS, ISO, IS etc.) relevant to the item must be complied with.

NCCD members – stakeholders acknowledgement

PARTICIPATION BY INDUSTRY IN PREPARING THIS DOCUMENT

NCCD members were reached out to, for being part of a series of interactions and consultative meetings were held with various stakeholders and manufacturers for their inputs. Cold chain users and members who are directly related to supply and installation of technology based equipment were referred with. The following lists the participants who held meetings, advised and interacted on the subject components with NCCD.

#	Meeting Date	Company Name	Name of Representative	Designation
1	22-Apr-2014	Spanker India Pvt Ltd	Mr. Birju Shah	Marketing Manager
2	22-Apr-2014	Gandhi Automation Pvt Ltd	Ms. Tulika Das Gupta	Manager-Marketing
3	23-Apr-2014	Dewas Techno Industries Pvt Ltd	Mr. Raghav Mittal	Marketing Officer
4	23-Apr-2014	Dewas Techno Industries Pvt Ltd	Mr. Dilip Kawathekar	Technical Advisor
5	23-Apr-2014	Dewas Techno Industries Pvt Ltd	Mr. Arvind Bansal	Business Head
6	23-Apr-2014	Maini Material Movement Pvt Ltd	Mr. Kiran Shetty	Business Lead
7	23-Apr-2014	Maini Material Movement Pvt Ltd	Mr. Sandeep Bajaj	General Manager
8	23-Apr-2014	Maini Material Movement Pvt Ltd	Mr. Amit Singh	Territory Manager
9	23-Apr-2014	Godrej & Boyce Mfg Co. Ltd	Mr. Navneet Duggal	Dy General Manager
10	23-Apr-2014	Godrej & Boyce Mfg Co. Ltd	Mr. Rajesh Bhowmik	Deputy Manager-Sales
11	23-Apr-2014	Godrej & Boyce Mfg Co. Ltd	Mr. Sandeep Singh Bhui	Assoc. Chief Manager
12	23-Apr-2014	Godrej & Boyce Mfg Co. Ltd	Mr. Abhinav Gulati	Asst Manager
13	24-Apr-2014	International Coil Ltd	Mr. Verma	Vice Pres.-Reefer Div
14	24-Apr-2014	Naturals Vegetables Fruits Storage	Mr. Yogesh Dahiya	Managing Director
15	24-Apr-2014	Naturals Vegetables Fruits Storage	Mr. Bharat Revar	Director
16	24-Apr-2014	Fresh Food Technology Pvt Ltd	Mr. Gautam Jha	Director
17	24-Apr-2014	Lanco Solar Energies Pvt Ltd	Mr. V. Saibaba	Chief Executive Officer
18	24-Apr-2014	Lanco Solar Energies Pvt Ltd	Mr. N. Devendiran	Director-Manufacturing
19	24-Apr-2014	Jindal Mectec (P) Ltd	Mr. Saurabh Jindal	Director
20	24-Apr-2014	Jindal Mectec (P) Ltd	Mr. Gaurav Jindal	Director
21	24-Apr-2014	Jindal Mectec (P) Ltd	Mr. Ravi Gupta	Vice President
22	24-Apr-2014	Jindal Mectec (P) Ltd	Mr. S. Sridhar	Advisor-Strategy
23	25-Apr-2014	Mayekawa India Pvt Ltd	Mr. Hiroyuki Egashira	Managing Director
24	25-Apr-2014	Mayekawa India Pvt Ltd	Mr. Arjun Singh	Mgr-Sales & Marketing
25	25-Apr-2014	Frick India Ltd	Mr. P. Sudhir Kumar	Vice President
26	25-Apr-2014	Frick India Ltd	Mr. R.K. Raghav	General Manager
27	25-Apr-2014	Bitzer India Pvt Ltd	Mr. Mohit Budhija	Manager-BD
28	25-Apr-2014	Bitzer India Pvt Ltd	Mr. Pankaj Gupta	Deputy Manager-Sales
29	25-Apr-2014	Thermofin	Mr. Parvinder Singh	Sales Manager
30	25-Apr-2014	Star Coolers & Condensors Pvt Ltd	Mr. Vijay Singh	Business Head
31	25-Apr-2014	Danfoss Industries Pvt Ltd	Mr. Maniam V.B	National Sales Manager
32	28-Apr-2014	Carel ACR India Ltd	Mr. S.K. Bose	Managing Director
33	28-Apr-2014	Lloyd Insulations India Ltd	Mr. K.K. Mitra	Vice Pres.-Technical
34	28-Apr-2014	Packolabel Systems Pvt Ltd	Mr. Neelkant Bakshi	Managing director
35	29-Apr-2014	Electrotherm India Ltd	Mr. Anurag Mittal	General Manager
36	29-Apr-2014	Jain Irrigations Systems Ltd	Ms. Swarilipy Maity	Manager BD
37	29-Apr-2014	Waaree Energies Ltd	Mr. Ajit Pandey	DGM - BD
38	29-Apr-2014	National Productivity Council	Mr. Nakul	Assistant Director
39	29-Apr-2014	Intersolar Systems Pvt Ltd	Mr. Bhupinder Kumar	Director
40	29-Apr-2014	Pluss Polymers Pvt Ltd	Mr. Samit Jain	Director
41	29-Apr-2014	Pluss Polymers Pvt Ltd	Mr. Harshit Vyas	Deputy Manager

#	Meeting Date	Company Name	Name of Representative	Designation
42	29-Apr-2014	Pluss Polymers Pvt Ltd	Mr. Vishnu Sasidharan	Manager BD
43	30-Apr-2014	Tata Power Solar Systems Ltd	Mr. Amit Kumar	General Manager
44	02-May-2014	Emerson Climate Technologies	Mr. Sanjay Kapoor	Head-Channel Sales
45	02-May-2014	Lamilux India	Ms. Cosima Klinger-Paul	Director
46	05-May-2014	Owens Corning Industries Pvt Ltd	Mr. Nilesh Sonawane	Leader-BD
47	06-May-2014	Indicon Enterprises Ltd	Mr. Ravinder M. Rana	General Manager
48	06-May-2014	Indicon Enterprises Ltd	Mr. Mahesh Chandra Dixit	Asst. General Manager
49	06-May-2014	ACR Project Consultants Pvt Ltd	Mr. Harsh Surange	Director
50	06-May-2014	ACR Project Consultants Pvt Ltd	Mr. Arvind Surange	Director
51	06-May-2014	Global Cold-chain Alliance	Mr. Atul Khanna	President India

Their personal participation is appreciated and an acknowledgement of their active support in India's cold-chain development. The draft document was prepared and released on 9-May-2014 at a conclave to Departments, States, Ministries, and public for further inputs.

The draft document was also shared with CII's Task Force on cold-chain and discussed over a three months period. The CII Task Force thereafter informed in-principle approval to these minimum system standards. The CII Task force will also pursue development of individual equipment specifications with Standard setting Authorities such as BIS, BEE, FSSAI and others. The PHD Chamber of Commerce also provided valuable support giving recommendations and technical inputs from the PHDCCI Task Force on Logistics Management.

This document was approved by the national Committee on Technical Specification, Standards, Test Laboratory and Product Certification on 5-December-2014 in a meeting held at Krishi Bhawan, New Delhi. The Committee members:

1. Shri Sanjeev Chopra, Joint Secretary (DAC, Ministry of Agriculture)- Chairman
2. Shri Pawanexh Kohli, Chief Advisor & CEO NCCD - Co-Chairman
3. Director General of Bureau of Indian Standards (BIS), New Delhi
4. Director General of Bureau of Energy Efficiency (BEE), New Delhi
5. Director General of National Productivity Council (NPC), New Delhi
6. Prof G. Venkatarathnam, Head Refrigeration & Airconditioning Lab, I.I.T., Chennai
7. Shri Mahendra Swarup, President - Federation of Cold Storage Association of India
8. Shri Ashok Mirchandani – Managing Director, Asia-Pacific, Carrier Transicold
9. Shri K. K. Mitra - Vice President, Lloyds Insulation Ltd.
10. Shri P. Ravichandran – Chairman, CII Task Force & President Danfoss Industries India.
11. Shri Gurmit Singh – MD, GMH Agri Hub
12. Shri Naresh Kohli – CEO, Harshna Group of Companies
13. Shri Arvind Surange – Chairman, ACR Project Consultant
14. Shri Atul Khanna – Director, ICE Centre of Excellence & Global Cold Chain Alliance India

Clarifications on the document and components may be issued by NCCD as and when necessary. Revision to the technical standards adopted shall be updated by NCCD as necessary when improved technologies and efficiencies are introduced/understood/approved.

Information GLOSSARY

Item	Description
AMC	Annual Maintenance Contract. System where the vendor / supplier agree to maintain the equipment installed by periodic check-ups & replace parts whenever needed. Can be signed with many vendors for different equipment.
APMC	Agricultural Produce Market Committee Act. Except for 7 states, all others have APMC to regulate sales and levy taxes on agri-produce.
Automatic Controller	Automatic control is the application of control theory for regulation of operating machines without direct human intervention. These controllers are linked to sensors to regulate energy usage and running hours depending on various trigger points (temperature, CO^2, Humidity, product stored, etc.).
Alternate Power sources • **Biomass** • **Solar Photo-Voltaic** • **Solar Thermal** • **Wind Energy**	Used by the facility over and above grid & DG set power ○ Biogas, also known as 'Gobar gas' ○ Biomass, agri-waste fuelled electric turbines, boilers. ○ Capture the Sun's energy thru PV cells & generate electricity ○ Capture the Sun's energy into heat absorbing medium. Captured heat is applied directly or used to produce power. ○ Harness the energy of wind thru windmills & produce power
Bar code/Coding	An optical machine-readable representation of data, showing data about the object to which it attaches. Can be used for traceability and farm coding.  
Bins stacking system	Plastic / wooden bins to store the produce. These are stackable (one on top of other). No half floors for storage are thereby needed. 
Blast Freezer	A special freezer room in which very cold air circulated by blowers is used for rapid freezing of produce like fish, meat, ice cream (< -18 °C products). In fresh farm produce, this is called pre-cooler (for chilled, mild chilled range). 
BTU	British Thermal Unit, a unit to measure energy. BTU is often used as measure of power (as BTU/h) in heating and air conditioning industries (12000BTU/h = 1 ton cooling = 3.517 kilowatts)

Item	Description
CA Store	Controlled Atmosphere cold store – a special category cold store where the chambers are sealed airtight & oxygen level controlled at very low level. Besides cooling, special CA equipment is also installed. Used in India mainly for long term storage of Apples.
Compressors	The heart or "pump" within an air conditioning system. Various types are used to compress refrigerant gas. The onsite engineer shall advise you on what type of compressors are in use.   **Reciprocating, Rotary, Screw, Centrifugal** (mechanical compression of gases and depend on electricity as motive power). **Absorption type:** very rare and creates compression like pressure by heating the refrigerant gas or other chemical process. Depends on solar thermal or other heating source for energy.
Cargo Material Handling equipment • **Conveyor belt** • **FLT / CBT** • **Hand Pallet** • **Cargo lift / VRC** • **Chain Lift**	Equipment used for easy handling, loading / unloading & moving of various items ○ Long moving belt carrying items on top of them. ○ Fork Lift or Counter Balance Truck (Diesel or Battery powered)  ○   Closed loop lift with repeating platforms usually used to move bagged cargo to upper floors.
Direct Expansion System	Wherein the compressed refrigeration undergoes volume expansion through an orifice or expansion valve, creating a cooling effect. Eg- deodorant aerosol spray. Is used in all domestic air conditioners, fridges, etc.

Item	Description
Data Logger	Portable instruments used to record temperature and humidity during the transport & storage period.
DG Set	Diesel Generating set for alternate power. Capacity measured in KVA or KW, each cold store must have at least one.
Evaporator	Indoor Unit where cooling process or heat exchange takes place.
Fire Detection & Fighting System • **Smoke detectors** • **Heat sensors** • **Hose / Hydrant** • **Extinguishers** • **Sprinkler** • **Gas based** • **Sand box / bucket**	Devices for detection of smoke & heat Pic. of a smoke detector 
Heat Recovery	Used in ventilation systems to recover energy from vented air.
kVA	Kilo Volt Ampere used to measure source power like for DG sets or grid power (kVA x power Factor = kW)
kW	Kilo Watt to measure electrical load (100KVA = 80 KW, output is 80% of electric input)
Indoor Unit Evaporator types • **Open tube** • **Finned tube** • **Plate** • **Diffuser**	The indoor cooling unit (usually suspended from ceiling or wall) where the cooling effect takes place, usually installed with inbuilt fans. Modern systems are tubes with fins (like in home AC); older types are open tube (bunker coil type). For cooling fluids like milk a cold plate is used as primary heat exchange. Diffuser types use ducts to throw cool air across floors.
NCCD	National Centre for Cold chain Development. A Govt. of India organization under the Ministry of Agriculture. Incorporated by sanction of cabinet in Feb 2012 as a think tank for cold-chain.
Pack House	A working area for accumulating, sorting, washing, grading of agricultural produce. Can have a staging cold room with pre-coolers.
PEB	Pre-Engineered Building. Metal frame with pre-fab panelled walls.
PUF Panel	Poly Urethane Foam Panel; for insulation of modern cold rooms.
Pre-Cooler	A special chamber where the warm fresh produce (fruits, vegetables, items above 0 °C) is rapidly cooled down (within hours) to prepare for transport or storage (Blast freezer for frozen items). Usual cooling ranges are 4, 7, 10, 15 °C.
RCC	Reinforced Cement Concrete, used to segregate floors in old stores.
Refrigerant Gas • **Ammonia** • **Freon** • **CO2**	A gas that produces cooling (heat absorbing) effect while expanding or vaporizing. Different types of gas used in compression based technology. Ammonia is most common in industrial refrigeration. Freon (CFC) is common primarily in domestic refrigeration. Record type of refrigerant in use as informed by engineer.
Ripening Chamber	A chamber or room in which un-ripened / green fruits are ripened in a controlled process. Mostly used for green bananas, mangoes, papaya.
RFID	Radio-frequency identification (RFID) - a technology that uses radio waves to transfer data from an electronic tag, called RFID tag / label, attached to an object, through a reader for the purpose of identifying and tracking the object.

Item	Description
R-value & k-Value	R (Thermal Resistance)=ΔT / Q_A (temperature differential divided by Heat transfer per unit area). k (Thermal Conductivity)=W/(m.K) (watts per metre thickness per ΔT)
Racking system	A storage system made of metal and designed to over-stack boxes or pallets of cargo. This allows for vertical space utilization and hence improved capacity utilization. Goods are placed on each shelf space (rack). Usually such stores are single floor but very tall. 
Steel mezzanine platform	A half floor (not made of concrete) on which people can walk. Unlike metal racking which is a like a large shelf or rack system. 
Secondary Cooling system	Where the primary expansion based cooling is used to cool a second medium (usually brine water or air), which in turn is circulated to give cooling effect in the target area. In normal home AC's you witness primary cooling system as the primary evaporator (or cooling unit) is inside the space to be cooled indoor unit. But in large hotels and shopping malls, the primary cooling unit is outside, where it first is used to cool the air. This cold air is blown through AC ducts to individual rooms or the target areas – this is example of secondary cooling system. In commercial refrigeration systems, high density fluid (brine water) is first cooled and this is circulated through pipes inside the chamber to perform the cooling in the chambers (secondary cooling).
Sorting / Grading	Sorting and grading for fresh agri-produce. Can be done manually or by using specialized equipment & technology (conveyor belts, optical graders, size matching, etc.).
Sensors / Instruments • **Temperature** • **Humidity** • **CO2**	Special sensing instruments to automatically check the room temperature, moisture level and carbon dioxide level in the air. These are used by modern cold storages as well in transport units and retail shelves
U-Value	U = 1/R = Q_A/ΔT = k/L (R is thermal resistance, k is thermal conductivity, L is thickness of insulation)
Ventilation	Fresh produce needs oxygen to survive. Vents to refresh air are provided, these can be manual or automated (automatic controller)
Wooden mezzanine platform	Half height floor, similar as steel mezzanine except that wood planks are used to make each floor instead of steel.

Regular information updates on terms and terminology are updated in NCCD Newsletter and its Journal on Cold-chain Management. Readers may also find the publication on www.nccd.gov.in and on community interaction page at www.facebook.com/NCCD.India

Personal Safety when visiting cold spaces

On Field visits, Inspection Team is recommended to always follow the safety instructions provided by the cold storage operator. If entering a cold room, remember it is an enclosed space and may suffer from induced lack of oxygen. Always have an escort from the facility with you.

- Cold stores may have sub-zero chambers and can create sudden thermal shock and chill to the body. If entering a cold store, do not spend too much time inside the room. Each cold store will have a supply of warm jackets as needed.
- Refrigeration machines are located outside the cold rooms in open or inside a designated machine room. Stand well clear of operational machines; do not wear loose clothes like scarves that can get sucked into running fans.
- CA enabled cold stores can have pockets of very low oxygen levels - Do not enter a CA chamber unless it has been well ventilated.
- Ask permission before entering enclosed spaces that have not been opened for long periods. High CO_2 and low O_2 levels can be encountered, chamber should be ventilated.
- Do not enter any enclosed space without permission and then only when you are accompanied by an escort.
- Cold stores can have icy and slippery floors and are usually humid. Always wear proper anti-skid laced shoes when on inspections.
- If required, wear a hard hat, especially in cold stores with overhead storage.
- When visiting cold chambers designed for spices, wear the face mask provided at the facility - avoid inhaling strong spice aroma.
- Follow walking zones and markings to avoid mishap with machines and workers.
- Do not touch or press any buttons or switches at the facility visited.
- These facilities are primarily food zones – maintain personal hygiene when visiting cold stores. Do not conduct inspection if you are suffering fever, cold or contagious disease.
- If you hear any alarm, immediately evacuate to the closest exit and stand well clear at designated emergency area. Allow the operators to function.
- Return entry passes (if any) to the facility manager before leaving the location.

Appendix-I

- Technical Datasheets of Cold-chain Components

Codes and Standards for Reference

National Centre for Cold-chain Development
contact-nccd@gov.in

NOTES

F. No. 45-64/2010-Hort.
Government of India
Department of Agriculture & Cooperation
(Horticulture Division)

Krishi Bhawan, New Delhi
Dated: 15th May, 2015

Subject: Guidelines and Minimum System Standards for Implementation in Cold-chain Components – Reg.

The Guidelines and Minimum System Standards for implementation of Cold-chain Components/interventions prepared by National Centre for Cold-chain Development (NCCD), in consultation with various Government agencies and industry stakeholders are enclosed for circulation and dissemination.

These System Standards lay down the minimum requirements for development of cold-chain infrastructure and supercede the technical standards for cold-chain issued by this Department vide letter of even number dated February 25, 2010.

These standards are also available on websites of this Department, http://www.midh.gov.in; http://www.nccd.gov.in

(Anuradha Vemuri)
Additional Commissioner (MIDH)

1. Mission Director, State Horticulture Mission - all NHM States
2. Director (Horticulture/Agriculture) - all TMNE States
3. Chairman, NABARD, Mumbai
4. Managing Director, National Horticulture Board, Gurgaon
5. Managing Director, NCDC, New Delhi
6. Managing Director, NAFED, New Delhi
7. Managing Director, NHRDF, Nasik
8. Managing Director, SFAC, New Delhi
9. Deputy Director General (Horticulture), ICAR, New Delhi
10. Chairman, APEDA, New Delhi
11. Chairman, Coconut Development Board, Kochi
12. Joint Secretary, RKVY, Krishi Bhavan, New Delhi
13. Joint Secretary (Marketing), Krishi Bhavan, New Delhi
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Copy to:

PPS to Secretary (A&C)/ Additional Secretary / JS (MIDH)

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Cold-chain System Components

Guidelines & Minimum System Standards for Implementation in Cold-Chain

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