A3 STAGE-GATE REVIEW SERIES · UTILITIES

UTILITIES DESIGN & READINESS CHECKLIST

A design-and-readiness review for food-factory utilities — demand basis, steam, compressed air, refrigeration and chilled water, process water and effluent, and electrical power. Use it when the utility scheme is fixed at basic engineering, and again before utilities are handed over for commissioning.

VERSION 1.0 · JUL 2026   48 CHECKS · 6 SECTIONS   GATES: BASIC ENGINEERING · PRE-COMMISSIONING

HOW TO USE THIS CHECKLIST

1. Work through each section with the utility load schedule, P&IDs and single-line diagram in front of you. Tick only what is **demonstrable on a drawing, schedule or datasheet**.
2. Section 1 is a **hold point**: every later section rests on a diversified demand basis. Utilities sized by summing nameplate ratings are oversized in capex and unable to turn down.
3. Numeric values quoted are common industry references; **confirm against your process, site conditions and local regulation** before applying them.
4. Best run by process, utilities/MEP and project engineering together — with the operations team who will live with the turndown.

01 DEMAND BASIS & LOAD SCHEDULE

HOLD-POINT SECTION

Every utility downstream inherits this number. Get the diversity wrong here and no amount of equipment selection recovers it.

- [ ] A utility load schedule exists listing every consumer with its rated demand, operating pattern and simultaneity factor — not a sum of nameplate ratings.
- [ ] Design capacity is stated against a defined production basis (tonnes/day, shifts/day, operating days/year) and against the peak hour — not the daily average.
- [ ] Expansion allowance is explicit and separated from day-one demand — carried in mains, plant room footprint and civil provisions, not only in the machine rating.
- [ ] CIP, sanitation and start-up loads are in the schedule. In many plants the CIP peak — not production — sets steam and hot-water capacity.
- [ ] Turndown is specified per utility: the minimum stable load at night or single-shift running is checked against the equipment's minimum firing or loading point.
- [ ] Quality requirements are stated per consumer (steam dryness and purity, air class, water quality) rather than assumed uniform across the plant.
- [ ] A redundancy philosophy is agreed per utility (N, N+1, standby) against a stated acceptable downtime for each — before equipment is selected.
- [ ] Metering points are defined at plant and major-area level so the design basis can be verified against reality after commissioning.

02 STEAM GENERATION & DISTRIBUTION

The boiler is rarely the problem. Wet steam, trapped condensate and undersized mains are capacity you have paid for and cannot use.

- [ ] Boiler capacity and design pressure follow the diversified peak demand with an agreed margin; statutory approval under the Indian Boiler Regulations, 1950 is identified where applicable.
- [ ] Steam is generated and distributed at a pressure that serves the highest-pressure user and reduced locally at each consumer — not generated at the lowest common pressure.
- [ ] Distribution mains are sized on a velocity limit for dry saturated steam (typically 25–40 m/s) with the pressure drop checked over the longest run at peak flow.
- [ ] Mains fall in the direction of flow, with drain points at regular intervals and at every low point, riser base and before each control valve.
- [ ] Steam-trap type, size and discharge route are selected per application (drip legs versus process equipment) — not one generic trap specified plant-wide.
- [ ] Condensate recovery is designed and the target return percentage stated; flash-steam recovery is assessed wherever the pressure levels justify it.
- [ ] Culinary (clean) steam is specified wherever steam contacts product or product-contact surfaces, with the appropriate separation, filtration and feedwater treatment (3-A culinary-steam practice).
- [ ] Boiler water-treatment chemicals are food-grade where any carry-over to product is credible, and the dosing regime is documented.

03 COMPRESSED AIR

Air that touches product is an ingredient. Its purity class belongs in the specification alongside its pressure and flow.

- [ ] Demand is stated as free air delivered at the point of use, with the leakage allowance shown as a separate line rather than buried in the total.
- [ ] Purity is specified as an ISO 8573-1 class triplet (particles : water : oil) for each network, with the food-contact network specified separately from the utility network.
- [ ] Oil-free compression is specified where air contacts product or product-contact surfaces — an oil-lubricated machine is not made oil-free by filtration alone.
- [ ] Dryer type and pressure dew point are matched to the coldest condition the pipework will see, including outdoor runs and lines entering chilled or frozen areas.
- [ ] Generation pressure follows the highest genuine point-of-use requirement plus distribution loss; a plant-wide setpoint raised to serve one machine is flagged (each extra bar costs roughly 6–8 % more energy).
- [ ] Receiver volume and the control strategy (load/unload versus variable speed) suit the demand profile, so short peaks do not drive installed compressor capacity.
- [ ] Distribution is a ring main where practical, in a corrosion-free material, with take-offs from the top of the main and drainage at low points.
- [ ] Point-of-use filtration and regulation appear on the P&ID for every food-contact application, with filter change-out and integrity checks written into the maintenance scope.

04 REFRIGERATION & CHILLED WATER

Usually the largest single electrical load in a food factory — and the one most often sized on a peak that never occurs.

- [ ] Cooling load is built up per zone and per consumer (product pull-down, infiltration, occupancy, lighting, equipment, fresh air) rather than by an area rule of thumb.
- [ ] Product pull-down duty — the time to bring incoming product to target temperature — is stated separately from the steady-state holding load.
- [ ] Refrigerant selection is recorded with its safety classification, GWP and machinery-room requirements; phase-down obligations are considered across the plant's life.
- [ ] Temperature levels are rationalised: a single low-temperature loop is not used plant-wide where a secondary, higher-temperature loop would serve most consumers more efficiently.
- [ ] Chilled-water ΔT is specified and the pumping scheme (primary/secondary, variable flow) is designed to hold it — low-ΔT syndrome is designed out, not commissioned out.
- [ ] Cold rooms have specified envelope U-values, a continuous vapour barrier, door protection (lobby, air curtain or strip) and under-floor heating where sub-zero over an unheated slab.
- [ ] Heat rejection is checked against site design ambient and wet-bulb, with make-up water consumption and any heat-recovery opportunity assessed.
- [ ] Defrost strategy, evaporator drainage and condensate routing are designed so that drip, ice or condensate can never fall over open product (FSSAI Schedule 4).

05 PROCESS WATER, TREATMENT & EFFLUENT

Water arrives as one quality and leaves as several. A plant that never drew the balance discovers it at the effluent plant.

- [ ] A water balance exists — intake, treated streams, ingredient water, CIP, utility make-up, losses and effluent — stated for both the average and the peak day.
- [ ] Water used as an ingredient or contacting product meets IS 10500 potable requirements (or the applicable local standard), with the treatment train and monitoring points specified.
- [ ] Softening, RO, UV or chlorination trains are sized on peak instantaneous demand with storage for interruption — and their reject streams are carried back into the water balance.
- [ ] Storage tanks are food-grade, sealed against ingress, fitted with filtered vents, fully drainable and cleanable, with turnover fast enough to prevent stagnation.
- [ ] Hot-water and CIP demand is stated per circuit — volume, temperature and frequency — rather than as a single plant total.
- [ ] Effluent is characterised by stream (volume, BOD, COD, oil and grease, pH, TDS) before the ETP is sized, and strong streams are segregated at source where practical.
- [ ] The treatment scheme meets the discharge or reuse conditions in the applicable CPCB / State Pollution Control Board consent, with the sludge handling and disposal route defined.
- [ ] Recovery and reuse routes are identified with their permitted end uses (non-product first) and the additional treatment each one requires.

06 ELECTRICAL POWER, STANDBY & METERING

A load list that is never diversified becomes a transformer you pay for twice — once in capex, then every month in fixed demand charges.

- [ ] A load list exists with connected kW per consumer, demand and diversity factors, and the resulting maximum demand in kVA.
- [ ] Transformer capacity, supply voltage and the sanctioned load from the utility are confirmed against that maximum demand plus the agreed expansion allowance.
- [ ] Standby generation covers a defined essential-load schedule — cold chain, safety systems, controls, critical process — rather than the whole plant by default, with fuel autonomy stated.
- [ ] UPS is specified for controls, instrumentation, servers and safety systems, with defined autonomy and a maintainable bypass.
- [ ] Power-factor correction is specified and coordinated with the harmonic content of variable-frequency drives; detuned reactors are considered where harmonic loading is significant.
- [ ] Earthing and lightning protection are designed to IS 3043 and IS/IEC 62305, with a separate clean earth for instrumentation where the control system requires it.
- [ ] Hazardous-area classification (combustible dust or solvent) is complete and equipment protection types match it; installation follows the CEA Safety Regulations and IS 732 wiring practice.
- [ ] Sub-metering by area and by utility is installed so specific energy consumption (kWh per tonne) can be tracked from the first month of operation.

ENGINEER'S NOTE

The most expensive utility mistake we see is not undersizing — it is sizing every utility for a simultaneous peak that the production plan never creates, then running the plant at 30 % load where none of the equipment is efficient. Build the demand schedule hour by hour for the worst realistic day, including the CIP window, before anyone selects a machine.