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ESSAY TYPE QUESTIONS:

1) What action has to be taken when a compressor is not working?

Ans: **(a) Compressor-1/ 2 over load red indication LED glowing**

(i) Ensure both the condenser motors are working. If not follow the instructions for rectification of condensor motors problem.

(ii) Check the working condition of RSW5. If it is not working, bypass it. If supply not available, check the continuity of wire No. 48 at outgoing terminal of RSW5 from C2, C3 contactors.

(iii) Check over load relays (OL-4, OL-5). If

(a) They are in tripped condition, check the over load setting (10-14 A) and reset it.

(b) OL-4 and OL-5 are found defective; bypass them by shorting 52 with 54 and 63 with 65.

Note: Before bypassing OL-4 and OL-5, ensure 3-ph supply is available at T10, T11, T12 for CP1 and T13, T14, T15 for CP2 terminals of compressors to avoid single phasing and measure the load taken by the compressors in each phase.

(iv) Check MCB-4 & MCB-5 and ensure supply voltage of 415V AC, 3- ph at outgoing terminals of MCB-4 (352, 353 and 354) of CP-1 and MCB-5 (355, 356, 357) of CP-2. If found defective, bypass it.

(v) Check the incoming terminals of contactor (C4) (331, 332, 333) of CP-1, contactor (C5) (334, 335, 336) of CP -2 and outgoing terminals of contactor (C4) (310,311,312) of CP-1, contactor (C5) (313, 314, 315) of CP2 respectively. If found defective, bypass the contactors.

(b) HP1 or HP2 red LED glowing

(i) Check the working condition of the condenser motors as per the procedure.

(ii) Check the condition of HP1/HP2 cutout switch. If tripped, reset it manually. (Setting 415 PSI)

(c) LP1 or LP2 red LED glowing

(i) Check the load of respective compressors with clip on meter. If current drawn is less than 6.5 Amps, replenish gas where ever possible.

(ii) Ensure that return air filters are clean.

(iii) Check and ensure that all the grills are in open condition.

(iv) Check the direction of rotation of blower as per the procedure.

(v) Check LP1 or LP2. If defective, bypass by shorting 29, 31 for LP1 and 35, 37 for LP2.

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2) (a) How do you provide through feeding DC – DC for an AC coach?

Ans: **POWER PANEL TO/FROM AC CONTROL PANEL (U/S TYPE)**

(i) Switch OFF AC plants before extending TC from DC Power Panel to DC Power Panel.

(ii) Remove 250A Inverter +VE, -VE fuses in the power panel for one of the inverter supply.

(iii) Extend the DC supply from (2514 or 2513) terminals of power panel of healthy/defective coach to terminals of (B +VE, B -VE) control panel of defective/healthy coach with 2 core 35 sq. mm copper cable as shown in the figures.

(iv) After ensuring through feeding connections, re-insert the 250A fuses of the inverters in both the healthy and defective coaches.

(v) Remove the battery fuse of the defective coach.

(vi) Switch on AC plant by balancing the load on both coaches to avoid over loading of healthy coach Alternators and batteries.

(b) How do you provide through feeding AC – AC for an AC coach?

Ans: **THREE PHASE AC FEED EXTENSION PROCEDURE - PANEL TO PANEL**

(i) When Inverter is not working due to low battery voltage, extend the TC from the adjacent coach AC control panel

(ii) Switch off the AC plants and inverters in healthy and failed coaches before extending TC.

(iii) Disconnect the existing incoming supply cables in AC control panel of the defective coach at terminal block before RSW1 (TB,TY, TR).

(iv) Extend 3-ph AC supply with 3 core 16 sq.mm copper cable from the AC control panel of healthy coach (TB, TY, TR) to AC control panel of failed coach (TB, TY,TR)

(v) Check the control supply. If it is taken from sine wave output of inverter, remove the same and extend supply from 2-phase of the bus bar (358, 359) to incoming terminal of MCB-8.

(vi) After ensuring the connections, switch on the inverter in the healthy coach and check the availability of 3-ph supply as well as control supply in the control panel of failed coach.

(vii) Switch on blower in the defective coach and check the direction of rotation of blower.

(viii) If shows air loss indication, interchange any two phase wire in the terminal block (TY, TB and TR).

(ix) To avoid over loading of inverter, switch on AC plants of both coaches either with one compressor in each AC plant of defective and healthy coach or two compressors in any one AC plant of defective/ healthy coach.

3) How do you provide E.F.T to a TL coach?

Ans: The detailed procedure of emergency feed extension is given as under

(a) Action to be taken in healthy coach

(i) The availability of power supply in the emergency feed terminal should be ensured.

(ii) Only one dark coach should be extended feed supply from one healthy coach.

(iii) Before connecting, the polarity of healthy coach as well as dark coach shall be checked.

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(iv) L-II circuit of the healthy coach shall be switched off before connecting supply to dark coach.

(v) The rotary switch of (socket paralleling main) SPM-I and II shall be kept in ON position.

(b) Action to be taken in defective coach and feed extension

(i) L-II and fan circuit of the dark coach shall be switched off before connecting supply from healthy coach.

(ii) The rotary switch of (socket paralleling main) SPM-I and II shall be kept in ON position.

(iii) The L-I circuit is having essential/emergency lighting circuit. This includes all lavatory lights 50% of compartment lights, and night lights in all types of IInd class coaches.

(iv) Remove (+ve) fuse from battery box and (-ve) main fuse from junction box to disconnect the power supply to/from battery.

(v) The earth fault shall be checked up with the help of testing lamp. If earth fault is there then feed extension should not be done.

(vi) The feeding shall be given to L-I circuit only of the dark coach from healthy coach.

(vii) The defective coach shall be attended and cable should be removed at the first available opportunity by TL staff.

(viii) The size of the cables for the feed extension shall be of 16 sq.mm PVC Aluminum / 2.5 sq.mm elastomeric /2.5 sq.mm e-beam copper cables.

(ix) The length of the wire for feed extension shall be 2x1.5 meter (for both terminals). The length of the cable shall not be more than 1.5 meter.

(x) Both ends of the cable shall be provided with suitable size of lug.

(xi) The cable shall be secured tightly by the screws or bolts, nuts and plain washer. The proper tightness of the connections should be ensured.

4) Answer any two of the following:

a) How do you provide emergency feed for an alternator (both RMPU & U/S coach)?

Ans:

(i) Before extending the separate excitation or providing emergency feed, ensure continuity of the alternator field wires with multi meter.

(ii) Remove the existing field wires (F +VE, F -VE) at RRU/ ERRU terminal block.

(iii) Remove field fuses in the RRU/ ERRU.

(iv) Extend 9 cell connections (18V supply) from battery as follow.

- Connect the wire from first cell positive terminal to alternator field +VE terminal duly providing switch control in between at main door handle, for switching OFF the separate excitation while stabling.
- Connect 9th cell -VE terminal to alternator field -VE terminal.

b) What action has to be taken when AC, lights & fans are not working in AC coach?

Ans:

(i) Ensure the position of RSW1 in Alternator-I/ Alternator-II/battery position. If it is found defective, bypass it.

(ii) Check the battery fuses. If blown out, replace it.

(iii) Check the inter-cell connectors of battery for open circuit.

(iv) Check the battery fuse bases for tightness.

(v) Check the continuity of Battery +VE, -VE cables in the power panel extending from the under-gear junction box.

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(vi) Check the working of inverters for AC & AC fans to work properly.

c) What action has to be taken when WRA is not working?

Ans:

(i) Check for availability of 3-ph supply at inverter selector RSW3. If supply not available on output side of RSW3, bypass it.

(ii) Check the incoming (4151, 4152, 4153) and outgoing (4157, 4158, 4159) terminals of MCCB and ensure availability of 3-phase supply. If found defective bypass it.

(iii) Check for availability of 3-ph supply at inverter selector RSW7. If supply not available on output side, bypass it.

(iv) If MCB trips again due to internal fault of the motor, change the position of RSW7 to the another motor.

5) What action has to be taken when an inverter is tripping when AC plants is switched ON?

Ans. **(a) <u>At AC Control Panel</u>**

(i) Switch off all MCBs of blower, condensers, compressors, heaters in the control panel (MCB-1 to MCB-6).

(ii) Switch 'ON' the inverter again. If the inverter is working on off load, Switch 'ON' the AC plant equipment MCB's one after other.

(iii) Switch 'ON' blower MCB-1. If inverter not tripped, switch 'ON' condenser motor-1 MCB-2.

(iv) If inverter not tripped, switch 'ON' condenser motor-2 MCB-3.

(v) If inverter not tripped, switch 'ON' compressor-1 MCB-4.

(vi) If inverter not tripped, switch 'ON' compressor-2 MCB-5.

(vii) Switch OFF faulty equipment MCB on which the inverter trips.

(b) <u>Inverter Tripped on 'OFF LOAD'</u>

(i) Check for fault indication in the inverter panel.

(ii) Check for short circuit/earthing of power cables between Inverter output and AC control panel terminals.

(iii) If no fault is found, then give message to next major station for necessary attention.

(c) <u>Inverter Tripping on Stabling</u>

(i) Check the individual cell condition. Isolate/ bypass the defective cells.

(ii) Check the input DC voltage at inverter. It should not be less than 90V to avoid input under voltage fault.

(iii) Even now if the voltage is not improved, provide TC from the adjacent coach AC-AC supply or DC-DC supply depending upon the condition as per procedure.

6) What are the items to be checked during trip maintenance to avoid fire in coaches?

Ans:

i. Ensure correct size of cables are provided for different circuits

ii. Ensure availability of cleats for cables

iii. Ensure availability of fire retardant PVC grommets wherever cables pass through holes, slits, apertures, etc,.

iv. Ensure that cables are terminated in junction boxes, terminal boards, etc,. with properly crimped lugs.

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v. Ensure cables are not having any intermediate joints and terminated at junction boxes, terminal boards.
vi. Ensure proper locking and securing arrangements for doors and covers of control/ power panels.
vii. Ensure no coach leaves primary maintenance depot with earth leakages.
viii. Always use the insulating fire retardant low tension (FRLT) tape.
ix. The IR values of the equipments should not be less than 2MΩ for 110V & 230V when measured with 500V megger and not less than 3MΩ for 415V when measured with 1000V megger.
x. Ensure proper rating of HRC fuses and MCB's.
xi. Ensure vane relays of RMPU's must in working condition
xii. Ensure OHPs of Heaters in RMPU must in working condition
xiii. Ensure OVP's in working condition
xiv. Ensure fans, lights, etc,. be connected to supply by proper connectors.

7) Explain the special drive launched recently to avoid fire in AC & TL coaches and earlier fire fitness certificate items?

Ans: **Earlier format of fire fitness certificate:**

Sl. No.	Train No	Coach No	+ve Leakage	-ve Leakage	Heating symptoms at junction box	Tightening of loose connections	Condition of HRC fuses	FNE of Cells	Condition of OVP in RRUS	Working of Vane Relays	Working of Over Load Relays	Condition of fire Extinguishers	DetectorsCondition of Earth Leakage

New format of fire prevention certificate:

AC coaches:

Sl. No.	Date	Train No.	Coach No.	Working condition of Vane Relay	Working condition of OHP	Earth Leakage	Condition of rewire able fuse	Working condition of OVP	Working condition of Thermostat

TL Coaches:

Sl. No.	Date	Train No.	Coach No.	Earth Leakage	Loose connection	Rewire able fuse	Incorrect rated fuse	FDB	OVP	EFT

8) What are the duties of escorting mechanics?

Ans: **DUTIES OF AC COACH MECHANIC**

i. Should be available in the coach one hour before schedule departure of the train.
ii. Check logbook of the coach for any entry by the maintenance staff and act accordingly.
iii. Check the condition of V-belts in stable condition. It should be 6+6 from the primary depot.

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iv. Check OFF load battery voltage. It should be 118V.
v. Record all parameters of the equipment in the logbook.
vi. Check whether the coach is pre-cooled or not. If not, pre-cooling should be done after placement of the train and pre-cooling should be removed 10 minutes before departure of the train.
vii. Switch OFF one of the AC plant before removing pre-cooling cable from external supply.
viii. Check all the grills inside the coach. These should be in open condition.
ix. Check all lights, emergency lights, fans, night lamps, reading lamps & mobile charging sockets.
x. Attend complaint of passengers, if any.
xi. Should do temporary connection in TL coach also, if required.

9) What are the duties of attendants (Technical & commercial duties)?

Ans: As per railway board letter No. 2006/TG-V/12/1 dated: 21/01/2009.

(A) **DUTIES OF AC COACH ATTENDANT (Technical Duties)**

(i) To appear in prescribed uniform and have his badge fixed on it so as to easily identify by the passengers.
(ii) To be present well before the schedule departure of the train.
(iii) To check that all internal electrical fittings in the coach provided for the comfort and safety of passengers are intact and in working order.
(iv) To monitor electrical/mechanical defects developing in the coach and call maintenance staff for attending whenever necessary.
(v) To assist the AC coach in charge in pre-cooling the coach well before commencement of the journey.
(vi) To take reading of pressure at panel board, discharge pressure of refrigerant and oil pressure of compressor and voltage, current of the alternators and battery etc., from time to time and make entries in the log book and inform AC coach incharge incase of any abnormalities in the readings.
(vii) To assist the AC coach incharge in the rectification of minor faults in the AC coach equipment enroute.
(viii) To remain with the AC coach when it is detached in enroute during sick marking till the coach is attached, made fit & move thereafter either base depot or any other terminal from where it is to be put back in service.
(ix) To attend training course as and when deputed by the administration.
(x) To carry out other duties such as cleaning electroplated fittings and assisting AC mechanics in maintenance of AC coach when spare at headquarters.
(xi) To carry out such other duties as may be assigned to him from time to time by ACCI/TTE.

(B) **INSTRUCTIONS FOR AC ESCORTING STAFF (Commercial Duties)**

(i) To appear in prescribed uniform and have his badge fixed on it so as to easily identify by the passengers.
(ii) To carry out such other duties as may be assigned to him from time to time by ACCI/TTE.
(iii) To check tickets of passengers when they first enter the coach to occupy berths/seats, if TTE/Conductor is not available to exercise the checks. He should not allow any person without proper tickets to supervision/direction of the conductor of the coach.
(iv) To accommodate passengers joining enroute under the supervision/direction of the conductor of the coach.
(v) To distribute bedrolls to the passengers.

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10) What are the latest modifications recommended by RDSO in AC coaches?

Ans: Latest modifications recommended for AC coaches are given below:

(i) Standardization of Pre-cooling plug & socket in all SG AC coaches.
(ii) Conversion of air-conditioning system of under slung type AC coaches from R-12 to R-134 refrigerant.
(iii) Checking for Emergency Light Unit.
(iv) To prevent corrosion in the liquid receiver of AC coaches.
(v) Modification of connecting between 18 KW brushless alternator terminals and junction box terminals of AC coaches.
(vi) Modification Sheet to prevent fire hazard in canvas duct in under slung type AC coaches.
(vii) Provision of extension for feeding power supply to an unhealthy AC coach fitted with RMPU from the adjacent AC coach.
(viii) Provision of modified terminal board assembly in 4.5/18/25 kW alternators.
(ix) Provision of vane relay in the blower motor circuit of AC coaches.
(x) Modification to housing assembly of return and fresh air filter provided in RMPU.
(xi) Modification for 25 kVA on board type inverter of M/s Siemens make for RMPU of AC coaches confirming to RDSO specification No. SPEC/E-20/04 (Rev. '3').
(xii) Provision for individual fuses in the AC control panel for individual condenser fan.
(xiii) To ensure working of RMPUs in the event of failure of one condenser fan motor.

11) What is the difference between SG AC coaches and LHB AC coaches?

Ans:

Sl.No	Item description	SG AC Coach	LHB AC Coach
1	Air condition system Control	Electronic Thermostat	Micro processor
2	Power panels	NPP and PP side panels	Integrated switch board cabin
3	Control circuit Voltage	110 V Ac, control transformer415/110 V AC	110 V Dc , 110/110 V DC-Dc converter
4	No of Sensors	Only two Nos temperature sensors	Six temperature sensors
5	Humidity control	Not available	Available
6	Solenoid coils	Not available	(i)Two Nos bypass solenoids (ii)four Nos control pressure switches
7	Temperature setting	Fixed setting	Set point generator with 7 points fine control
8	Measuring Gauges	No pressure measuring gauge available	All four units transducer based LP&HP measuring facility available
9	Motor protection	Only provided MCB	MPCB provided for all motors
10	Lighting Control	Individual switch control	Control from Panel through contactors & individual control
11	Heater Thermal protection	OHP only available	OHP &ESTI (Fusible link protection at 130 ◦C) are available
12	Access for Blower HP & LP Cut-outs etc	Access from inside the coach	Only Access from roof.

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13	Fresh Air/Return control	Not available	Flapper Motor control available
14	Fresh Air Filters/ Return Air Filters	provided under the roof in corridor.	Provided on roof instead of providing in corridor.
15	Fans	AC / DC Fans provided	Fans not provided in these AC Coaches.
16	Berth Indications	Available on night light dooms.	Not Available.
17	Corridor Lights	Fluorescent and CFL	Fluorescent
18	Night Lights	Screw type / CFL	LED provided in gangway FT's
19	Mirror Lights	Screw type / CFL	NIL
20	No of Berths	FAC-18/22, ACCW-46/48, ACCN-64	FAC-24, ACCW-52, ACCN-72
21	Mobile charging	100 VA inverter/ Distribution/Tr.	Distribution transformer
22	Vane relay	Available	Not available
23	Blower Motor	1.5HP,1420 rpm without thermal protection inside motor	1.5HP,1420 rpm with Embedded thermal protection inside motor
24	Condenser Motor	1HP,900 rpm without thermal protection inside motor	1HP,1400 rpm with Embedded thermal protection inside motor
25	Cables junction box	Ordinary Terminal board connection	Harting connector

12) What are the advantages and additional features provided in LHB coaches?

Ans: Air conditioning control system is of microprocessor based.

(i) Power panels are of Integrated Switch Board Cabinet type.
(ii) There are six temperature sensors are available for sensing the temperature.
(iii) Humidity control is available in LHB coaches.
(iv) Two no's of bypass solenoids and four no's of control pressure switches are available.
(v) Set point generators with 7 points fine control are available.
(vi) MPCB provided for all motors.
(vii) OHP & ESTI (Fusible link protection at 130 ◦C) are available.
(viii) Blower motors of capacity 1.5HP, 1420 rpm with embedded thermal protection inside motors are available.
(ix) Condenser motors of capacity 1HP, 1400 rpm with embedded thermal protection inside motors are available.
(x) Two alternators and double set of batteries are available.

13) What are the refrigerant control devices used in AC system and explain the functions?

Ans: Mainly three types of refrigerant control devices are in use.

Thermostatic expansion valve: - This valve operates by sensing the temperature of the suction side after the evaporator. The valve opens more when the heat load is high and closes when the heat load is low. This is accomplished by a sensing bulb of the TEV clamped o the suction side.

Automatic expansion valve:- This is valve is also called as Constant pressure expansion valve. It is a spring loaded valve by which it maintains a constant pressure in the evaporator. If the heat load is high, the valve opens more due to increase in pressure of the evaporator and vice versa.

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Capillary tube:- the capillary cube consists of a very small diameter and the length depended upon the size of the system This tube is usually soldered to the suction line between the condenser and the evaporator to effect the necessary heat exchange. This tube acts as a constant throttle on the refrigerant, and due to its length and small diameter, offer sufficient resistance to the flow of refrigerant to build up a head pressure of an amount needed to produce condensation of gas.

Apart from the three main types of refrigerant control devices mentioned above, Hand expansion valve and Float valves are also available.

14) Write short notes on (a) Refrigerator (b) Water cooler (c) Window type AC units (d) Air filter in AC system (e) Evaporator in refrigerator system (f) Dry and wet bulb temperature (g) Condenser and (h) Sealed compressor of AC unit?

Ans:

a) Refrigerator: - Refrigerators operate on the Vapour compression system having hermitically sealed compressor mounted at the base of the cabinet. Refrigerant used is R-22 or 134A. Expansion valve used is capillary tube. The evaporator piping is fastened round and brazed to the freezer box. The condenser tube is placed over a single metal sheet for dissipation of heat. The top space is freezer unit and the rest of the cabinet interior gets cooled by convection currents of air set up by freezer unit.

b) **Water cooler**: - Water cooler is a machine working on refrigeration system for cooling water for drinking purpose. The refrigeration system is same which is utilized in air-conditioning, refrigerators, etc. Generally two types of water coolers are used i.e., Instantaneous water coolers and storage type water coolers. In addition to the above two types there are also storage-cum-instantaneous type also. The drinking water having temperature between 10˚C to 13˚C is preferred.

c) **Window type AC units**: - These are completely self contained units, with the compressor, condenser, evaporator, refrigerant piping and air filter, all assembled in a very compact assembly. The window units are usually of ½ to 2 tons capacity and fitted with 230 volts motor. The refrigerant is controlled with the capillary system. The unit is so designed that it can be mounted on the window with small bracket from outside.

d) **Air filter in AC system**: - Air filters are used to maintain cleanliness / dustproof. There are mainly two types of air filters. Viz., Return air filter is to remove any dust present in AC room/Coach and fresh air filter is used to filter fresh air for dust etc.,

e) **Evaporator in refrigerator system:-**This constitutes the cooling unit, in which the liquid refrigerant under low pressure evaporates and in doing so, it takes away its quota of latent heat, there by cooling the medium surrounding the cooling coil.

f) **Dry and Wet bulb temperature:-** Dry bulb temperature is the temperature of air as measured by an ordinary thermometer.

Wet bulb temperature is the temperature of air as measured by an ordinary thermometer, whose glass bulb is covered by a thin cotton sleeve soaked in water.

g) **Condenser**:-It is intended for cooling the hot gas and liquefying it under pressure. It may be air cooled or water cooled

h) **Sealed compressor of AC unit**:- The motor and the compressor unit is housed in one casing and completely sealed. The suction and discharge piping is brazed as no valves are used, the chances of leakage is eliminated.

15) What are major differences in equipment and operation of Air conditioning system under slung and RMPU equipped coaches?

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Ans:

S. No	RMPU	UNDER SLUNG
1	Compressor Motor, Condenser motors, Blower motors are 3-phase AC Induction Motors	DC Motors are used which works on 110 V DC
2	Sealed type compressor is used	Compressor is open type
3	Uses 4 compressors per coach. Hence Capacity can be varied from 25 to 100%	Uses only 2 compressors per coach. Hence capacity can be varied from 50 to 100%
4	The compressor condenser evaporator and motors are all assembled in one package unit and situated on the roof.	The compressors condensers and its motors are sunder slung
5	Requires inverter for running the AC plant	Do not requires inverters
6	Uses refrigerant R-22, approximately 3 Kg/plant	Uses R-12 approximately 15 Kg per plant
7	Hermitically sealed system and hence No pressure gauges, Valves etc.,	Service valves and pressure gauges and hand set of valves are used
8	Uses all 3-phase AC Contactors and relays	Use of DC Contactors
9	The expansion device used is Thermostatic expansion valve	Capillary tube is used
10	WRA is used	WRA is not required as water tank itself is situated on roof.
11	The plant can be pre cooled by connecting direct 3-phase supply from outside source with the help of change over switch.	The pre cooling of AC Coach is done by using pre cooling transformer-rectifier unit

16) Explain the Refrigeration system?

Ans: The refrigeration system consists of 4 basic major components and refrigerant.

Compressor, Condenser, Expansion device and evaporator. The refrigerant system depends for its action on latent heat principle and expansion principle. The refrigerant in gas form is sucked into the suction side of the compressor and compressed to high pressure. From the compressor, the gas goes through a condenser which removes the sensible heat generate in the gas due to compression as well as, the latent heat and the gas liquefies. The liquid gas passing through an expansion valve into the evaporator is expanded to gas absorbing the latent heat in the process, thus cooling the cooling coil. The gas having taken up its latent heat in properly designed cooling coil is now dry and is again sucked into the compressor to continue on another cycle.

or

REFRIGERATION CYCLE

Refrigerants are heat-carrying medium, which during their cycle in the refrigerant system absorb heat at a low temperature level and discard the heat so absorbed at a higher level. The refrigerants common used are R-12, R-22, R-134a.

The refrigerant have boiling points much below ordinary room temperature, so they exists as gas and are only held in the liquid state by keeping them under pressure.

Refrigeration can be produced by allowing a liquid refrigerant from high pressure vessel to pass and boil inside a coil or evaporator. The latent heat needed for the boiling is taken from the surrounding space of the evaporator, thereby cooling the space. After passing

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from evaporator, the refrigerant is reclaimed with the help of compressor. The compressor compressed the vapour to the pressure corresponding to a saturation temperature, higher than the temperature of naturally available air or water. The compressor also circulates the refrigerant through the system.

The refrigeration cycle thus comprise of:

- Absorption of heat by the evaporation of a liquid refrigerant in the evaporator at a controlled lower pressure.
- Raising the pressure of the low pressure vapour coming from the evaporator by the use of the compressor.
- Removal of heat from the high vapour in the condenser so as to liquidity or condense the vapour and
- By the use of the throttling device, reducing the pressure of high pressure liquid (from the condenser) to the level of pressure needed in the evaporator.

17) What are the items to be checked in under gear of a SG AC coach (RMPU)?

Ans:

a. Existence of Alternators safety chains with original bolts and split pins.
b. Alternator suspension hanger pin with cotter pin.
c. Alternator Suspension pin with nylon bushes.
d. Alternator pulley with nut and split pins.
e. Proper alignment of Axle pulley and Alternator pulley.
f. Tap the Axle pulley with hammer and judge the tightness by sound.
g. Check suspension of battery box for signs of any cracks, corrosion, rusting and take remedial action immediately.
h. Check cracks of all the suspended equipments like Pre cooling transformer, regulators, WRA
i. All V- Belts are intact without any twisting. Tension should be felt by striking it slightly. Belt in correct tension will respond ‘alive’ and ‘spring back’.
j. Proper fitment of tension mechanism by maintaining 50mm gap between bracket and free end bush collar.
k. Proper tightness of terminal connections with cleat and clamp, proper securing of wiring, etc.
l. Check for availability of grommets for all incoming and outgoing cables.

18) What are the advantages of VRLA batteries over conventional flooded batteries?

Ans:

S. No	Conventional flooded batteries	VRLA batteries
1	Regular maintenance involving topping up with distilled water is required.	No periodic topping is required.
2	There is a possibility of ground currents due to electrolyte spillage.	No electrolyte spillage due to dry leak proof construction.
3	There is a possibility of shedding of active material due to vibration in service.	Shedding of active material is minimized as highly compressible glass mat separators are used.
4	These batteries are mounted vertically hence the gravitational force is high.	These batteries are mounted horizontally hence the gravitational force is low.

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5	Post corrosion is usually observed due to the acid mist.	No post corrosion since there is no acid mist.
6	Cracking and rebounding of sealing compound is common	Cell covers and jars are hermitically heat sealed.
7	The self discharge rate is up to 4% of capacity per week	The self discharge rate is 0.5 to 1.0% of capacity per week
8	Transit damages are high because of brittle rubber containers	VRLA batteries are housed in steel trays which can withstand drops and shocks during transit.
9	The average discharge voltage is 1.90 V per cell	The average discharge voltage is 1.95 V per cell
10	Separate battery charge room and charging at site is required.	These batteries are factory charged and commissioning is immediate.

19) What are the advantages of conventional flooded batteries over VRLA batteries?

Ans:

S. No	VRLA batteries	Conventional flooded batteries
1	These are costly	These are cheaper
2	These cells are sensitive for charging	These are robust for charging
3	These are very sensitive to over voltage / current	These are not so sensitive to varying voltages/ currents
4	Open circuit/ reversal of cell is frequently observed in enroute	Open circuit of cell in a battery is very rare
5	Costly and fine tuned battery chargers are required	Ordinary charger will serve the purpose
6	Correct regulator settings are to be maintained	Little variation in voltage setting will not affect the batteries performance
7	Ripple content should be less than 2%	Ripple content may be allowed up to 15%

20) Procedure to maintain correct tension of new 'V' belts on bogie transform mounted alternator of AC Coaches and non AC coaches?

Ans:

a) Provide alternator on the bogie.
b) Provide axle pulley on the wheel.
c) Provide 'V' belt of matching set between grade 48 & 52 on wheel axle, on which, the axle pulley is provided.
d) After lowering and completion of buffer head adjustment of bogie, provide 'V' belts over alternator towards the axle pulley.
e) After completion of provision of V belt, remove the split pin check nut and fixing nut of free end side tension rod spring tightening collar nut.
f) Free the check nut and fixing nut of U clamp side of tension rod.
g) Now insert the tension rod assembly between the bogie supporting bracket and eye (leg) of the alternator.
h) Provide bolt for 'U' clamp of tension rod and eye of the alternator.
i) Then slowly tighten the fixing nut (U clamp side) unit tension indicator match with the spring collar. This will give the correct tension of the V belt.
j) Then provide fixing nut, check nut and split pin leaving a gap of 75 mm for AC coaches and 55 mm non AC coaches at free end side of tensioning for mechanism.

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k) Then observe the tension of belt.

21) (a) Explain the precautions to be taken before starting the engine?

Ans: **Precautions before starting the engine:**

a) Before starting the engine, ensure that necessary quantity of lubricating oil, fuel Oil and cooling water have all been filled. Also ensure that all switches are in 'OFF' position and all fuses are in good condition.
b) Switch ON the D.C. control supply switch, which will light the D.C. 'ON' indicating lamp.
c) Switch ON the Starter Motor isolation switch which connects D.C. supply from Starter battery to the starter motor circuit.
d) Press the test buttons TS-1, 2 and 3 to check the condition of the fault indication Lamps. When these buttons are pressed, those indicating lamps which do not glow should be replaced by healthy bulbs. Similarly healthy condition of 'FAULT' lamp can be checked by pressing the alarm isolation push button switch. Now switch OFF again the fault lamp. Engine stop/reset press button will have to be pressed before starting the engine.

(b) Explain the sequence of operation to start the engine?

Ans: Press the Engine Start push button of an Engine selected for duration, until the Engine attains the full speed. Following circuit functions are carried out:-

a) First N/C contact of the start push button opens the LOP (Low Oil Pressure relay) circuit. It is a positive interlock that ensures the Engine does not stop for want of lube oil pressure build up at the moment of starting. Second N/C contact opens the Engine starting circuit of the other plant. This is an interlock to prevent simultaneous starting of two Engines. Third N/C contact de-energizes the BIC which disconnects BCH from supplying to starter battery during starting.
b) One of its N/O contacts energizes FSRD (Time Delay Relay for Starter Solenoid) and FSS (Fuel Start Solenoid) and the other N/O contact energizes SC (Solenoid Coil) of the starting motor for cranking the Engine. When the engine attains full speed, the start push button should be released.
c) The instant contacts FSR of FSRD maintain the supply for FSRD and FSS. The N/C contacts of the start button and one of the relay contacts of FSRD keep the starter motor circuit open the prevent the accidental restart by means of start push button. Another N/C delay contact of FSRD keeps the LOP circuit closed. Once the Engine starts, the lube oil pressure developed, opens the oil pressure switch ICLOP (Internal Combustion Engine Low Oil Pressure) which keeps the LOP de-energized as long as there is sufficient pressure of lube oil.

22) (a) Explain the procedure of plant selection?

Ans: Keep the plant selector for switch as desired

a) Plant 'A' only: This is done by switching on ACB-1 manually. If it is desired to feed both feeder 1 and 2 from plant 'A', bus coupler contactor can be energized by pressing bus coupler 'ON' push button. Paralleling of alternators is prevented by the following mechanism. There are two N/C contacts (one each from each ACB), in parallel, in the bus coupler contactor circuit is closed through the N/C contact of ACB-2. Suppose in this situation, the ACB-2 is manually closed. This will result in the opening of the

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normally closed contact of ACB-2, which in turn will cut off the supply to the bus coupler contactor close coil, thereby resulting in opening of the bus coupler contactor.

b) **Plant 'B' only:** This is done by switching on ACB-2 manually. It is desired to Feed both feeder 1 and 2 from plant 'B' bus coupler 'ON' push button. Paralleling of alternators is prevented by the mechanism as already indicated above.

c) **Plants 'A' and 'B':** Both ACBs can be closed simultaneously but in this Condition the bus coupler cannot be energized by because the auxiliary N/C contacts of the two ACBs in the bus coupler close coil circuit will be open. Hence plant 'A' will feed only feeder 1 and plant 'B' will feed feeder 2.

(b) Explain the procedure for feeder selection?

Ans:

a. Operate "Power Supply ON" Set rotary, switch "DC-ISO A" on to position ON (IR)
b. Lamp DC-ON on panel II lights up (IR)
c. Set rotary switch "plant selection switch" to position "4 = plant A"
d. S2K9, S2K11 pulls in
e. S2K8, S1K10 do not pull in
f. Close manually ACB 1
g. Transformer-1 gets supply
h. Switch ON the Radiator and Exhaust fans in the engine room
i. Push key "Safety loop B on"
j. Push key "Feeder B on"
k. Contactors S2K13 and S2K3 pull in
l. Lamps S2H2 and S2S16H1 light up
m. Switch feeder B off
n. After a moment push key Feeder B ON
o. Push key "bus coupler"
p. S2K11, S2K2 pull in

Same procedure can be adopted for the other feeder and plant.

23) What are the protective devices provided in EOG power cars?

Ans:

a. High water temperature - "ICHT"

The high water temperature switch is mounted on the Engine and senses the temperature of water in the cooling jacket of the Engine. Once the ICHT closes, water is set at 95˚C for putting off the Engine.

b. Over speed of engine

Over speed switch ICOS mounted on the Engine senses the over speed when the Engine governor fails.

c. Low lube oil pressure

The lube oil pressure switch mounted on the Engine senses the lube oil pressure.

d. Alternator protection

The alternators are protected by individual Air circuit breakers (ACBs), with the following protective trips

i. Alternator overload

This protection is inbuilt in the ACB. The ACB has an integrated solid state relay which incorporates the following protections.

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i) Short circuit ii) IDMT & Overload iii) Earth fault

Whenever the overload condition is sensed, the IDMT relay picks supply to the alternator fault relay (AFR).

ii. Under voltage

When the voltage of the alternator falls below the set value of 687 volts, ACB is tripped.

e. Earth leakage

Core balance transformer operated earth leakage device E/L detects any earth fault caused either in the alternator windings or in the cables from the alternator to the control panel up to the core balance transformer.

f. Short circuit

This results in the instantaneous tripping of the ACB when the set value of the current is sensed.

g. Feeder protection

The two individual feeders are also protected by individual contactors, with the following protective trips.

i. Earth leakage

Core balance transformer operated earth leakage device. EL detects any earth fault caused in the feeder cables after the feeder contactor.

ii. Feeder overload

C.Y. operated bimetallic over load relay senses the overload in the feeders and N/O contacts of feeder fault relay (FFR) opens the feeder contactor circuit and thus the faulty feeder is isolated.

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