I beg to differ

Confused about vortex ring?
Even the professionals can't entirely agree, says
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I do not seem to have raised my head above the parapet recently, which I am quite fond of doing as it tends to liven debate; and if that debate involves flight safety it's worth sipping from the poisoned chalice.

The Summer 2016 issue of *Rotor Torque* carried an article on what is said to be a new, faster way to get out of the vortex ring state, known as the Vuichard recovery system after the Swiss flying instructor who developed the technique.

This 'silver bullet' is being marketed as a technique that allegedly allows the pilot to recover from the very high rates of decent associated with Vortex Ring State with minimum loss of height. Great! However, I personally need to see some more results, preferably via an independent test flight programme that would evaluate the technique and publish a meaningful report, before I am entirely convinced of its possible merits as an industry standard technique.

This technique seems to have been around for some time in various guises. Why has it not already become the industry standard, if it's as good as alleged?

There is some muddy water within the helicopter world as to the correct terminology to be used when referring to Vortex Ring State (VRS). Is it VRS or SWP – 'Settling with Power'? The Americans use both when talking about VRS, and also seem to use the term SWP when discussing high rates of descent caused by there being insufficient power available to arrest it. In the UK we use the term VRS when referring to high rates of decent caused by vortices generated within the main rotor disc, but use the term 'overpitching' when the rate of decent is due to insufficient power. Who is correct? In my humble opinion VRS is an aerodynamic problem, therefore we cannot use the same terminology as we would if the problem was one of power availability. So before we muddy the water further with the 'silver bullet' it might be useful if the helicopter world standardised the terminology.

Also, are the very small height losses talked about related to 'Fully Developed VRS (FDVRS)' or 'the Incipient stages of VRS (IVRS)'? The loss of height talked about is 20ft to 50ft – impressive, but clarify please: is that from IVRS or FDVRS? The rates of descent involved are not the same.

I would like to think these numbers are from IVRS, as we should be teaching recognition of the incipient stages of a critical flight condition and not, in this case, recovery from FDVRS. Also, consider the fact that when in FDVRS the flight controls become somewhat unresponsive. Therefore, the technique of raising the collective lever, left pedal and right cyclic would not, in my opinion, produce a crisp exit from the situation in any direction.

Does the fact that it will take the pilot an amount of time to recognise the condition before any recovery technique is used – say around 100ft height loss during the recognition stage, plus 20 to 50ft, get taken into account when stating such small height loss figures during any briefing on VRS? I would not be happy if the pilot comes away with the wrong impression of the total height loss. What really concerns me is the possibility that we might be leading the pilot into a more complacent view of VRS.

In the meantime, what flight conditions can result in very high rates of descent?

Vortex Ring State (VRS)

This is an aerodynamic condition involving recirculation – i.e., vortices generated within the main rotor disc. Ingredients required are:

- Low Indicated Airspeed - less than translational.
- A reasonable rate of decent (the rate of decent required to develop VRS varies with aircraft type as it is a function of disc loading).
- Some power applied.

Overpitching

This is a 'power available' problem (insufficient power available for a given increase in collective main rotor blade pitch angle).

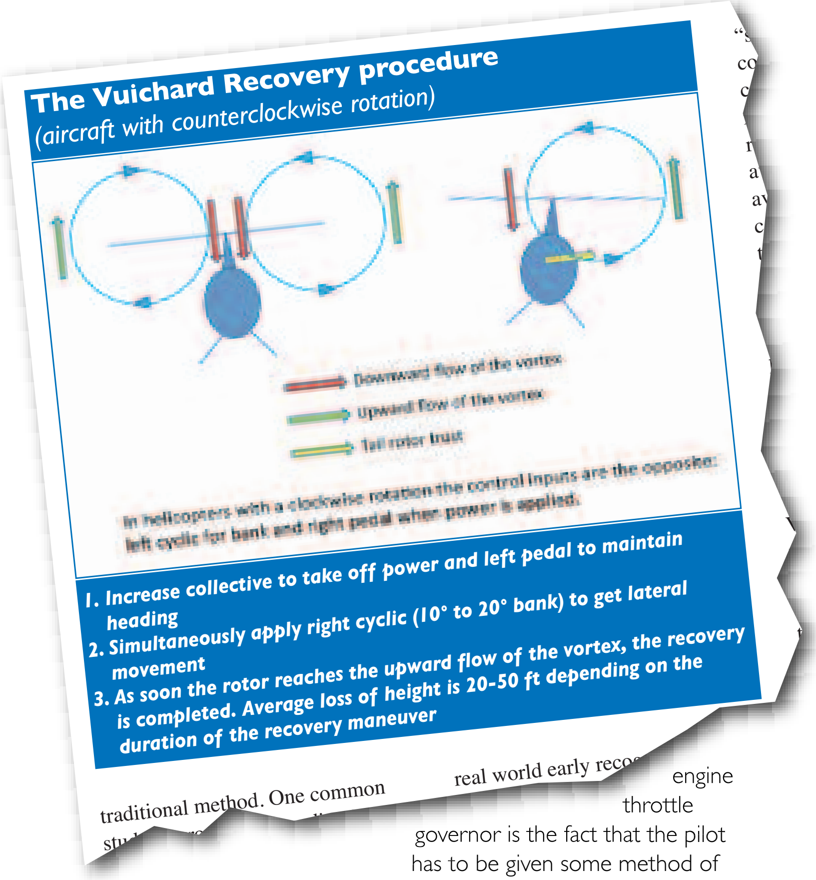
Ingredients required:

- Low indicated airspeed (wrong side of the power required curve).
- A reasonable rate of decent.
- Insufficient power available to arrest the rate of decent.

Both conditions can produce very high, non-survivable rates of descent; the latter could lead to low RPM rotor stall.

If we're going to use the recovery technique of raising the collective to max power available, left pedal and right cyclic (obviously this would differ according to the direction of rotation of the main rotor) should we not consider the following?

The technique seems to have been developed using a turbine engined helicopter, where the



The Vuichard Recovery procedure
(aircraft with counterclockwise rotation)

1. Increase collective to take off power and left pedal to maintain heading
2. Simultaneously apply right cyclic (10° to 20° bank) to get lateral movement
3. As soon the rotor reaches the upward flow of the vortex, the recovery is completed. Average loss of height is 20-50 ft depending on the duration of the recovery maneuver

traditional method. One common ... real world early reco

throttle is at the flight idle (fully open) position and fuel scheduling is via a power turbine governor (PTG) pneumatic or hydro-pneumatic control system – the pilot just raises the collective lever to demand more power. The pilot cannot override the governor.

What about the piston engine? The throttle is not in a set 'flight idle' position, it's somewhere between fully closed and fully open depending on the power being demanded by the pilot. The throttle has to be opened when demanding more power from the engine; in the Robinson R22 and R44 this task is controlled by the engine governor which will physically open the throttle for the pilot to maintain engine RPM. It's a very good system as long as the pilot treats it as an aid and not as a primary throttle control.

The 'Achilles heel' of this very good, remarkably responsive piston engine throttle governor is the fact that the pilot has to be given some method of over-riding the governor in the event of a governor fault. This function is given via a slipping clutch in the governor system; the pilot just has to increase his or her grip on the throttle to cause the clutch to slip, thus preventing any physical throttle movement, open or closed.

The turbine engine tends to have more power available – moreover, the pilot *cannot* override the governor, thus inadvertently preventing an increase in power to the rotor system when raising the collective lever and applying pedal. Therefore the physical reaction to a stressful event like VRS of gripping things tightly cannot affect the power increase to the rotor system.

Piston-engine helicopters tend to have less power available compared to a turbine engine, and the pilot *can* override the governor through the physical reaction to a stressful event by unconsciously gripping the throttle and preventing an increase in power to the main rotor when the collective is raised and pedal applied.

I see a possible area of concern when advocating the use of the 'silver bullet' as the standard VRS recovery technique in piston-engined helicopter types. Unconscious tight gripping of the throttle, a factor which has often featured in accident investigations, might drive the RRPM down to a low RRPM situation. When the low RRPM horn and caution light come on, they will add another critical flight condition for the pilot to deal with! And it's amazing how quickly things unravel!

Raise collective lever, left pedal, right cyclic – complicated! Good chance of pilot getting it wrong when stressed.

Ease the cyclic forward, fly into clean air, raise the collective lever – simple! The fact that the helicopter is descending will tend to produce a nose-down attitude due to the airflow striking the horizontal stabiliser and tail cone, so the attitude is already pitching in the right direction. Just follow it.

Having said all that, perhaps there is a valid use for the Vuichard technique in certain hostile environments and in utility work where there is never enough height for the standard recovery technique. If so, teach this technique to the professional pilots who would be operating in such environments, who will have the relevant skill-set and experience to hopefully be able to pull off the technique successfully.

Let's see some meaningful data. I'm not interested in demonstrations. If we are being asked to accept this as a standard recovery technique, I think the industry is owed some clarity, and real results of the standard produced by test pilots.

Finally, are there that many accidents that have correctly been attributed to VRS as the primary cause? They are difficult to identify positively because overpitching and VRS both produce high rates of descent and similar heavy impact with the ground. However, if we can prevent an accident, then let's do so.

Keep your RPM in the green and I will keep harping on!

Richard